TAYLOR - HOBSON

ENGRAVING MACHINES

(MODELS "C," "CB," "CX" & "CXL" MACHINES)

RESISTANCE ETCHERS & JAVELIN ETCHERS

INSTRUCTIONS
to be handed to the
OPERATOR

EDITION 37

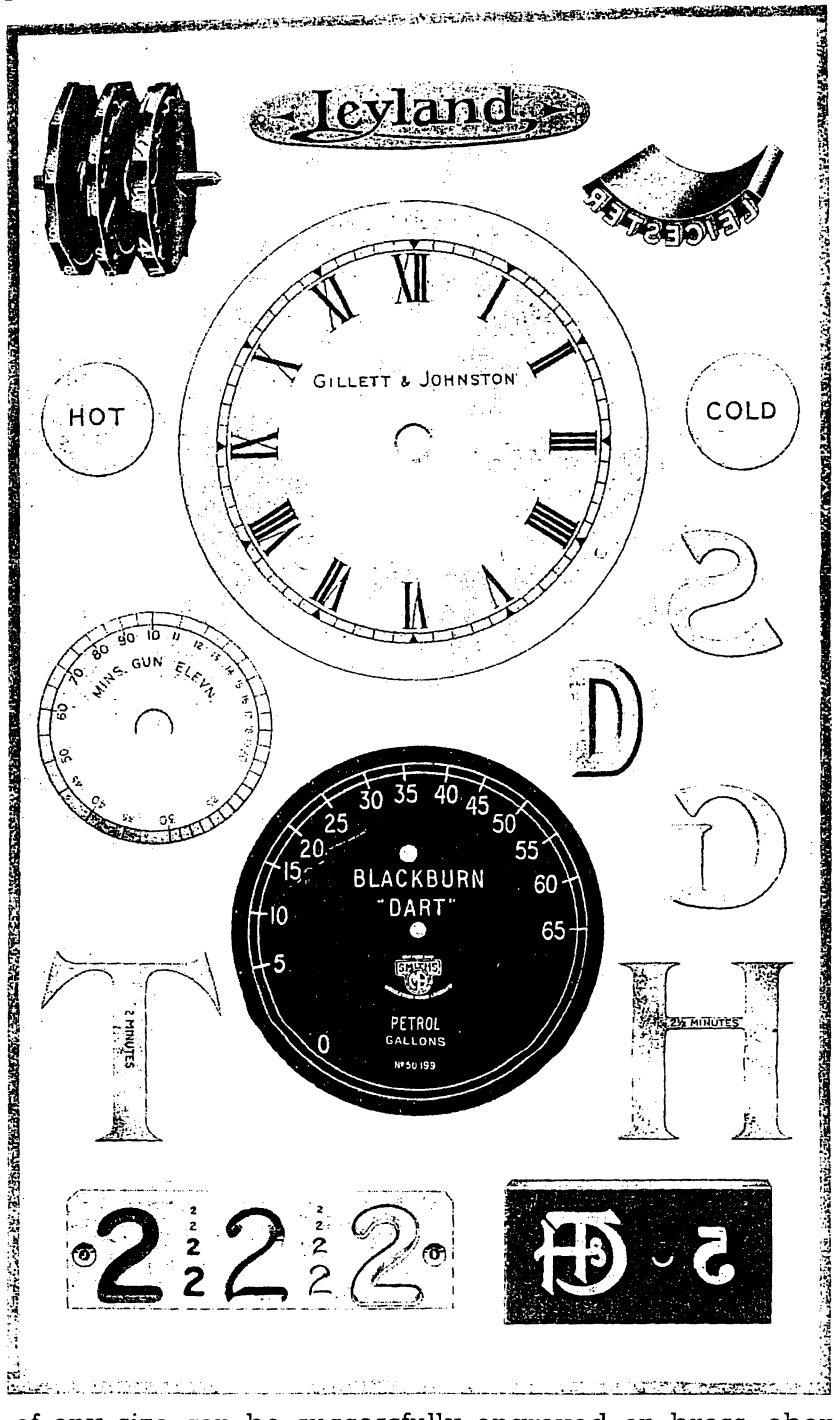
TAYLOR, TAYLOR & HOBSON LTD
STOUGHTON STREET WORKS
LEICESTER
London Office : 314 REGENT STREET, W.1.

Telegrams : LENSES, LEICESTER
Tel. : LEICESTER 20134 (two lines)

Codes : LIEBER, A.B.C.,
MARCONI & BENTLEY

EXAMPLES OF WORK

These examples were produced on Taylor-Hobson Engraving Machines



Intricate work of any size can be successfully engraved on brass, ebonite, steel, etc., and on curved or flat surfaces

CONTENTS

Introduction 5

Standard Equipment 6

General 7
How the machine works—Position for machine—Comfort of operator.

Erecting 8-12
"C" and "CB" Models—Fitting pantograph—Spindle and countershaft speeds—Countershaft—Driving Band —Adjustment for correct tension—Overhead motor—Compact Drive—"CX" and "CXL" models.

Construction and Adjustment 13-15
Cutter spindle type "A"—Cutter spindle type "E"—Adjustment for wear in cutter frame—Lubrication of cutter spindles—How to remove feed mechanism—Care of pantograph—How to adjust cutter frame and link, and slide screws—Care of countershaft and motors.

Operating 16-18
Cutter Feed mechanism—How to regulate depth of cut (three methods)—How to set pantograph and style—Reductions less than 1 : 2—Direct copying attachment—Equal pantographs—Work table—Extension table for large plates.

Copyholders, Copy and Cutter Measurement 19-27
Copyholders, standard and special—Standard line copy with range of sizes—Design and spacing of copy—Lengthy inscriptions—Sizes of copy and work—Multiple line copy—Stencil form copy—Use of style rollers—Microscope for checking cutters—How to control cutter—Set copies—Celluloid copies—Material for copy—Care of copy—How to grind pantograph style.

Pantograph Covering Capacities and Intermediate Reduction Schedules 28-33
Areas covered by cutter on "CX" and "CXL" models with schedules of reductions—Areas covered by cutter on "C" and "CB" models with schedule of reductions.

Circular Engraving 34-35
Dividing head—Dividers—How to balance and space characters for circular work—Eccentric work—12-inch circular table.

Cutters and Cutter Grinding 36-40
Care of cutters—Choice of cutters—How to grind cutters—Cutter shapes—Cutter speeds—Cutter Grinder model "D"—Care of grinding wheels.

Knife Dividing Attachment 41

The Engraving Machine in the Tool Room 42-45
Suggested uses on sheet metal work, slotting, cam cutting, press tools, coining dies and moulds—Special rig for grinding form cutters.

Special Machines and Forming Attachments 46-49
Type die machine—Presser foot—Forming Attachments for "C", "CB", "CX" and "CXL" models—Rolling Attachment.

Engraving on Non-Metallic Materials 50
Vulcanite, Bakelite, Wood, Marble and Glass.

Fillers and Filling 50-51
Kwikfyl—Durafilla—Silvalyne—Air-drying enamel paint—Ammonia bronzing.

Electric Etching 52-54
Resistance Etcher—How to connect up and use Resistance Etcher—Javelin Etcher—How to connect up and use Javelin Etcher.

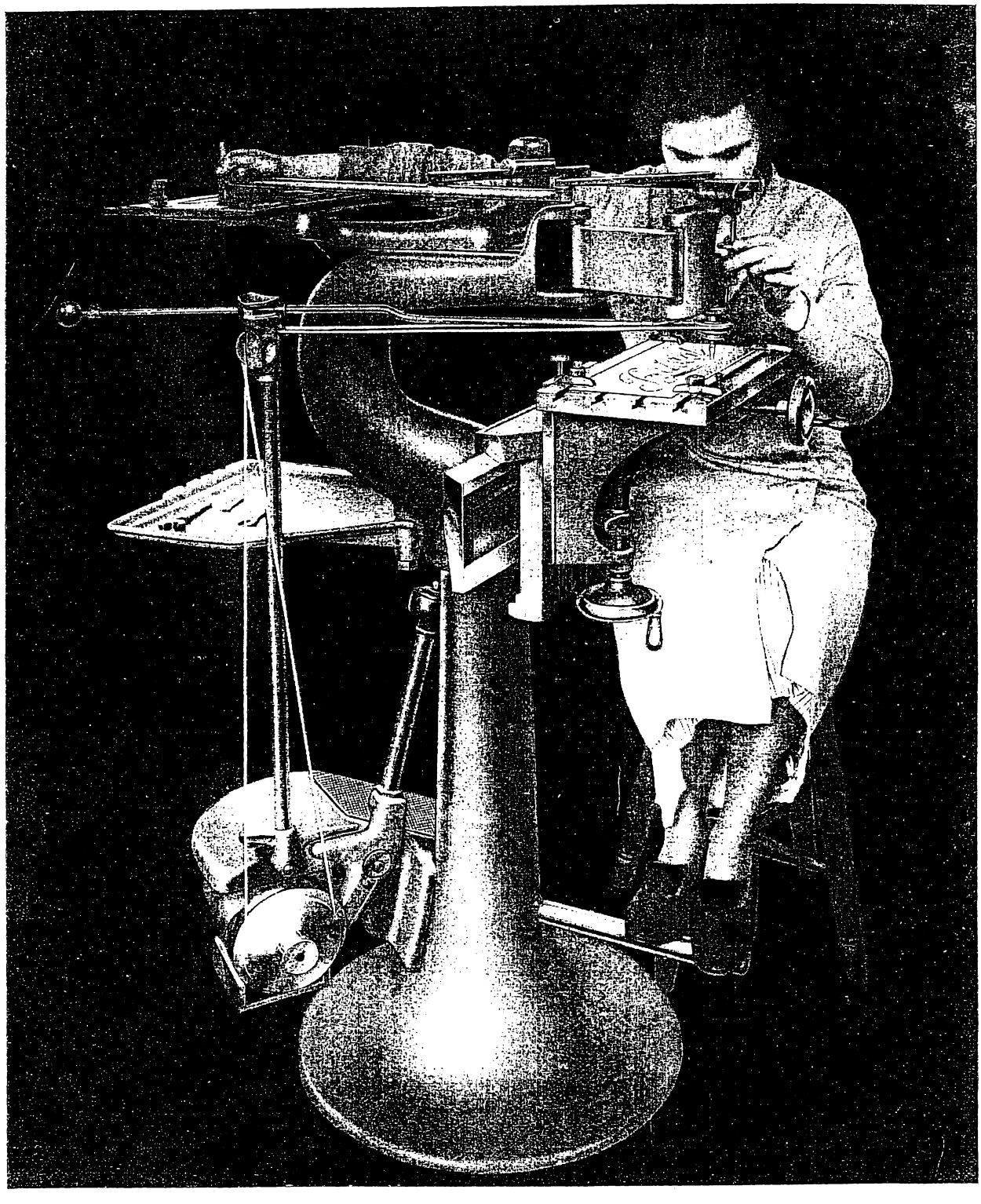


Fig. 1.—Operating a Taylor-Hobson Engraving Machine (Model "CX").

I N T R O D U C T I O N

The Taylor-Hobson Engraving Machine was the pioneer of its type. Since its inception it has maintained its pre-eminence and is to-day in use all over the world, being recognised as an accurate, versatile and reliable machine. It is built with extreme care and will do first-class work if maintained in good condition.

The Engraving Machine is made in four models :

1. **Model "C."** This machine is for all general work. See Fig. 2.
2. **Model "CB."** This is the same as the "C" machine except that the frame is bowed to accommodate plates up to 36 inches wide.
3. **Model "CX."** This machine will accommodate plates up to 39 inches wide. It has a larger pantograph and table and correspondingly larger copyholders.
4. **Model "CXL."** This has a similar specification to Model "CX" but has the further advantage of a 14 inch vertical slide, thus catering for bulkier articles.

In addition we manufacture a still larger machine known as the Pantograph Milling and Diesinking Machine, dealt with in a separate instruction book.

It is our earnest desire that users of these machines should obtain from them the greatest possible satisfaction and this booklet has been compiled with that end in view. It is important that it should be available to the foremen and operator. Send for a second copy if required for filing.

We are pleased at all times to give advice on the use of the machine and to make special attachments where these are required.

All orders for accessories and spare parts should be addressed to Stoughton Street Works, Leicester, excepting orders from the London Toll Area, which should be addressed to 314 Regent Street, W.1.

STANDARD EQUIPMENT

The machine is sent out complete with all necessary tools and wrenches, and the engraver should always make sure that he is in possession of the equipment specified below, otherwise it is impossible to use the machine properly.

EQUIPMENT WITH "C" AND "CB" MODELS

		Code No.
(1).	**Mounted grinding wheel** to fit the cutter spindle	110/9
(2).	**Cutter grinding socket** for holding cutters while grinding	110/125
(3).	**Magnifier** for examining cutter points	110/15
(4).	**Oilstone** for finishing cutters after grinding	110/19
(5).	**Style collar** for use when regrinding the style	KO25
(6).	Pair of **work clamps** with screws and nuts for holding work on the table	110/12
(7).	**Table fence** for squaring up work and work fixtures	110/11
(8).	**Pantograph slider wrench.** Also fits style jacket and work clamps ... } These two are continually required and should be attached to the machine by a cord	110/122
(9).	**Cutter wrench** for inserting and extracting cutters ... ... } These two are continually required and should be attached to the machine by a cord	110/120
(10).	**.3-in./24 wrench** for the table and saddle locking screws. (Also fits the cutter frame and frame link centres)	110/121
(11).	**½-in. box wrench** for the head and copyholder bolts and cutter grinding arm ...	110/124
(12).	**⅜-in. wrench** for the work clamps	110/123
(13).	**Wooden plug** for cleaning the cutter spindle and cutter grinding sockets ...	110/253
(14).	**6-inch Steel rule** in case, graduated in fiftieths of an inch for measuring intermediate settings of pantograph	110/312
(15).	**Instruction book** and transparent copy of areas covered by pantograph	
(16).	**Box of sample cutters**...	110/159
(17).	Two ⅜-in. Tee Bolts	110/247
(18).	Two ⅜-in. Nuts	0137

EQUIPMENT WITH "CX" AND "CXL" MODELS

As above with the exception of items 1 and 2 and with 12 inch Rule in case, instead of 6-inch rule. Code number of rule 110/313

Endless driving belt 110/217

A newer **"CX" type cutter grinder,** complete with the necessary accessories, is supplied as an extra with these models (see page 40).

GENERAL

The chief features of these machines are shown in Fig. 2. A copy of the engraving desired is arranged in the copyholder (K) and the article to be engraved is held upon the work-table of the slide-rest (S) beneath the cutter (N). The slide-rest has both horizontal and vertical movements. The cutter, rotated at a high speed by the driving band (Q), is lowered into the work or lifted from it by the operator, who controls the feed-screw (32) with the left hand, while the right hand guides the pointed style (G) along the lines of the copy. This action moves the cutter, which produces the desired engraving. The style (G) is connected to the cutter by means of the pantograph whose sliders (H) and (E) can be set along their graduated bars so that the engraving may be varied in size. Models "C" and "CB" have pantographs reproducing at one-third (1 : 3) to one sixteenth (1 : 16) the copy size—smaller reproductions with special settings. Models "CX" and "CXL" have, normally, pantographs reproducing between one-half (1 : 2) and one-sixteenth (1 : 16) the copy size—smaller reproductions with special settings. These latter models can be furnished with alternative pantographs copying at full size (1 : 1) and reproducing down to one-sixth (1 : 6) the copy size. The cutter spindle, feed mechanism, pantograph, cutter frame, frame link, head and copyholders are similar on all models but differ somewhat in detail as described later.

It is desirable that a skilled mechanic should be responsible at first for all adjustments and for teaching the operator how to run the machine and how to sharpen cutters.

An engraver must have plenty of light, and the best position for the machine is in front of a good window, the operator facing the light. A light (preferably electric) should be provided to illuminate the work when required ; it should be placed behind and slightly above the cutter and shaded so that it does not shine directly in the operator's eyes.

The operator should be seated on a stool about 2 feet high with the copyholder on the right. A convenient foot rest is attached to the machine pedestal.

An adequate supply of copy should be provided suitable for the work to be done, with an assortment of suitable cutters. The back of the workpan is provided with openings to hold cutters and tools in an orderly manner.

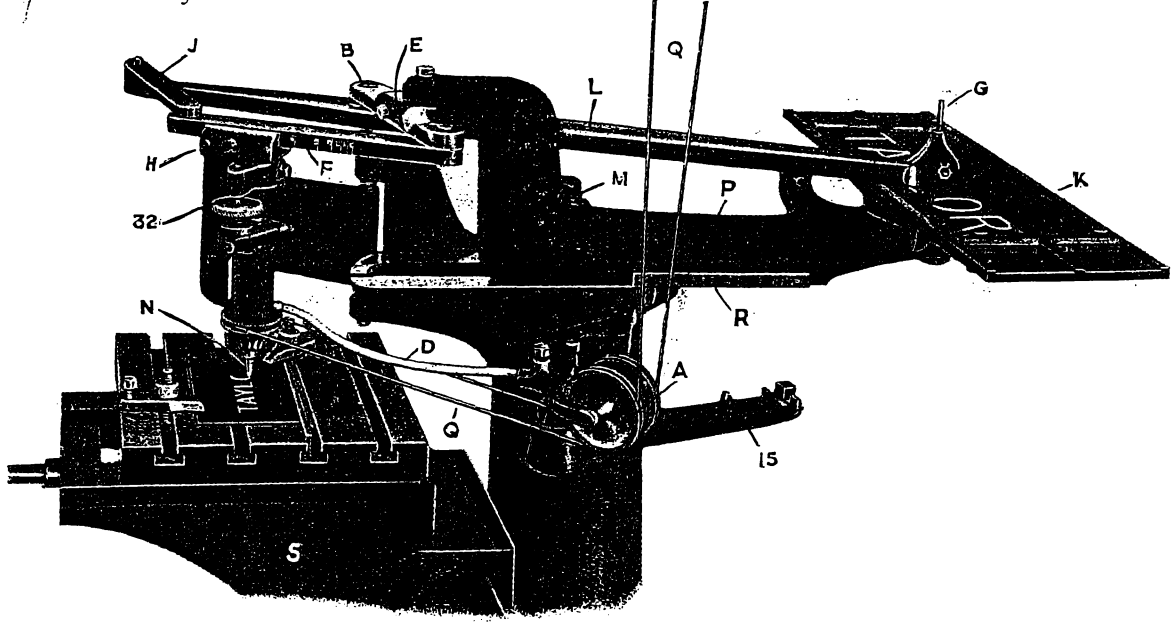


Fig. 2.—Upper portion of the Model "C" Engraving Machine. Front or operator's view.

ERECTING OF MODELS "C" AND "CB"

Every machine is completely erected in our works, thoroughly tested by skilled inspectors, and certified within close limits of error. To facilitate transit, the pedestal, frame, head, copyholder and pantograph are packed separately. Erect models "C" and "CB" as follows, after referring to Fig. 2.

(1). Place the pedestal on its side and insert the end of the footrest through the hole in the side, screwing up the nut from the inside.

(2). Locate pedestal in required position and with the straight edge of the top flange to the operator's left.

(3). Get the workpan bolt ready to put in the hole opposite the straight edge of flange, place the machine on the pedestal with flanges in line and at once secure it with this bolt. (In the case of the "C" type machine this bolt is inserted from above and the long stem carries the workpan. With the "CB" type machine the bolt is inserted from below and screws into the workpan). Insert the other bolts from below and screw home all three nuts.

Then refer to Fig. 3 and proceed thus :—

(4). Put the head (P) in place on the frame and clamp it with bolt (M) at the reduction marked 3 on the scale (R).

The bolt (M) screws into the head dog on the under side. Note that this head dog has one straight and one bevelled edge. The frame is shaped inside to match and the head dog fits one way only. The bolt must not be overtightened or the dog will break. It is so designed, rather than risk the splitting of the frame.

(5). Remove the bevel-bar (F) from the pantograph—it simply drops free—and slip it into the slider (H), the graduations on the bar and the clamp bolt on the slider both being to the front. Set the bar with the line marked 3 against the bevel edge of slider, and clamp by means of the hexagon head screw.

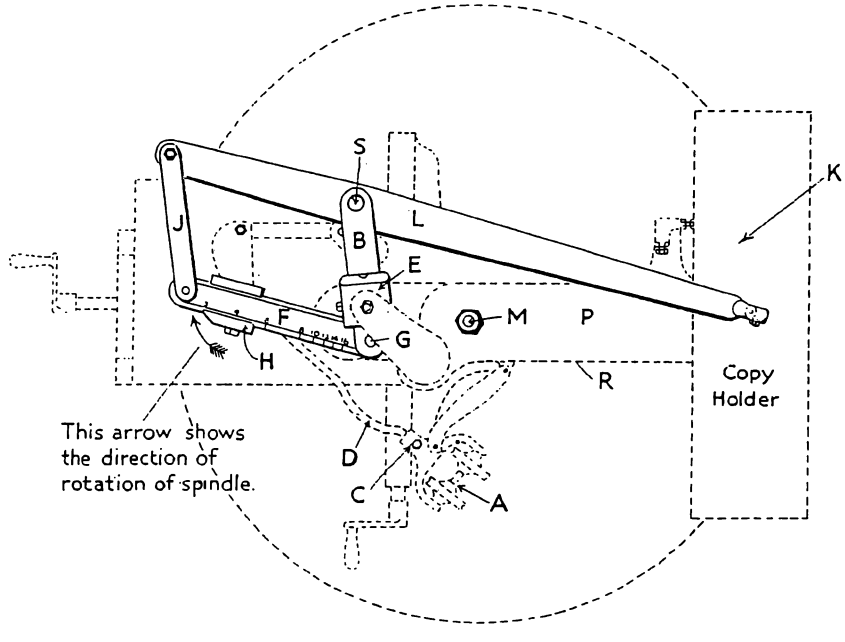


Fig. 3.—View from above of the "C" and "CB" Engraving Machines.

(6). Assemble the pantograph, holding it by the long arm (L) and fitting the holes in the bevel-bar (B) and the link (J) over the pins in bar (F). Do not allow the whole weight of the pantograph mechanism to hang on the ball-bearing in slider (H) or this may be damaged.

(7). Swing the pantograph round and insert the bar (B) in the slider (E) at its bevelled end. Set the bar with the line marked 3 against the bevel edge of slider, and clamp by means of the hexagon head screw.

(8) Clamp the copyholder (K) on to the head (P) by means of the bolt provided. The pantograph is now set for operation at 1 : 3 reduction.

If the floor is uneven, the base of the pedestal should be packed up so that the machine is rigid and level, otherwise the pantograph is apt to move of itself. It is seldom necessary to fix the machine to the floor.

SPINDLE AND COUNTERSHAFT SPEEDS

The ball-bearing spindle, now fitted as standard, has a two-speed pulley giving two different speeds. For light engraving, particularly in soft materials and with light cuts, the higher speed is desirable. With the countershaft driven at 1,000 r.p.m. and driving to the small diameter groove (Fig. 8) on the spindle pulley, the speed will be about 15,000 r.p.m., which will be found most suitable on work of this class. Changing the drive to the larger diameter groove reduces the speed to 7,500 r.p.m. suitable for cuts of heavier character on tool steel and other tough material. For heavy cuts in such material at this latter speed it will usually be found necessary to employ the special high speed cutters referred to on page 36. Even then it may in certain cases be found desirable to drop the speed to, say 4,000 r.p.m. given by a countershaft speed of 500 r.p.m.

COUNTERSHAFT

The countershaft should be fixed with $\frac{3}{8}$-inch bolts or coach screws to the ceiling or to some convenient support at least 10-feet above the floor. Fig. 4 shows the usual arrangement. The front (F) of the 12 inch diameter grooved pulley (G) should be located over the front guide pulley (A); the guide pulleys being in their mean position, *i.e.* with the style in the middle of the copyholder.

The pulley (G) may deviate from the position shown to as far as the dotted outline, providing its side (F) is kept over the pulley (A) as shown. The direction of rotation of pulley (G) must be to lead the belt ON to pulley (A).

The handle of the striking gear should be hung 5 feet above the floor by means of the cord provided. (Complete illustration on page 15).

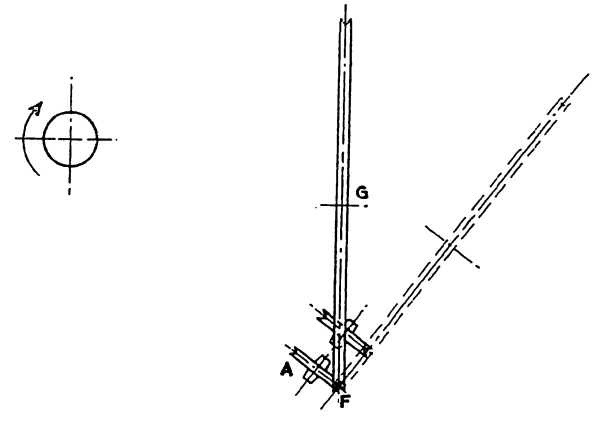


Fig. 4.—Plan of Countershaft Pulley in relation to Guide Pulleys.

DRIVING BAND

The band supplied with the machine is No. 12 gut band with No. 12 hook and eye fastener. Fit as follows :—

(1). Set the guide pulleys (A) in about their mean position on the stayrod (D), Fig. 3.

(2). Place the band over all the pulleys (see Fig. 2), pull it tight, and cut to length so that ends just butt together.

(3). Pare down the ends of the band slightly with a sharp knife and screw the fasteners on until the band projects through into the hook and eye proper.

(4). Sear off the projecting ends with a wire nearly red hot ; this will harden and swell the gut and further secure the fastener.

Put a drop of oil in the eye of the fastener.

Endless Fabric Band

For fine work a non-vibrating endless fabric band is supplied to order. These endless bands must be made to measure. To find what length to order, set the guide pulleys (A, Fig. 3) as near the spindle as possible along the stay rod (D), then stretch a piece of light cord tightly round all the pulleys like a driving band. When ordering, specify the total circumferential length—not the double length—of the band.

DRIVE TO COUNTERSHAFT

The 3 inch pulley of the countershaft should be driven by a 1 inch leather belt. *The drive must be so arranged that the belt moves downwards on leaving the edge (F) of the pulley (G).* The fork of the striking gear can be directed up or down and must be set to engage the belt as it passes *on* to the 3 inch pulley. The cutter spindle should revolve *clockwise* when viewed from above.

OVERHEAD MOTOR

If an overhead motor is used in place of the countershaft, the pulley must be set in alignment as already indicated. The diameter of the pulley must be chosen to give the cutter spindle-speeds stated, and care must be taken to see that the pulley is fitted securely. There should be a local flat or hole on the motor shaft to receive the screw in the boss on the pulley. This screw must be tight.

The motor must revolve in the same direction as indicated for the countershaft.

If our type M1 ceiling drive bracket is employed, a two step pulley can be fitted to the motor, giving a greater speed range. In this instance, a point on the pulley midway between the two belt diameters is set in alignment over the guide pulleys. The bracket adjusts the motor for height as necessary for the two belt grooves. It is operated by a length of piping reaching down to the operator. This piping is supplied amply long and should be sawn off about 6 ft, from the floor just below one of the crossholes drilled to fit the pin in the handle. The handle can then be fitted.

We offer a suitable $\frac{1}{4}$ h.p. motor complete with pulley and switch. Full details of electric supply must be given when ordering. The speed range available with the two step pulley is as given for the compact drive. (Complete illustration on page 15).

COMPACT DRIVE

This is an alternative to the countershaft or overhead motor and makes the machine fully self-contained.

It is fitted at the Leicester works and is supplied complete with belts and with a length of rubber covered cable for connecting to the electric supply. The earth wire (clearly marked) should be connected to a water pipe or some suitable "earth" connection to conform to Board of Trade regulations.

Figs. 5 and 6 show the arrangements of the belts.

Give full details of electric supply when ordering.

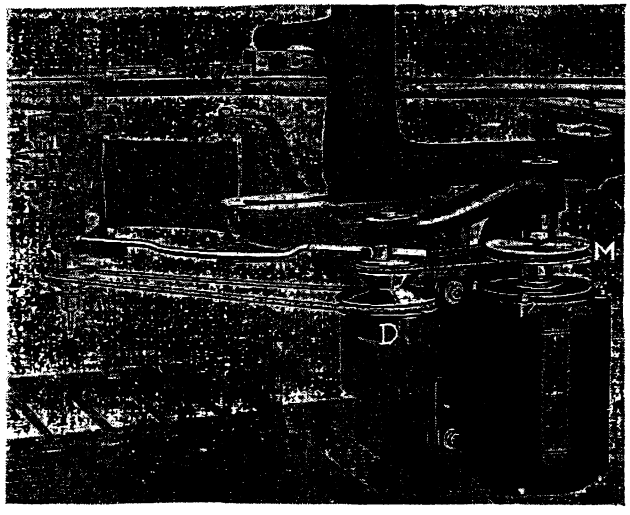


Fig. 5.—Type M2 Compact Drive for "C" Models.

The "C" and "CB" Machines are normally fitted with the type "A" Cutter Spindle (see page 13) and the speed range is obtained by moving the belt between the driving pulley (D) and cutter spindle. The belt to the motor pulley (M) remains fixed as illustrated.

The motors fitted to the Compact Drive are not of the universal type, and are suitable only for the electric supply for which they are ordered.

Speeds with type "A" Cutter Spindle :—

Large step on pulley (D) to small step on spindle pulley	20,000 r.p.m.
Large step on pulley (D) to large step on spindle pulley	9,250 r.p.m.
Small step on pulley (D) to small step on spindle pulley	7,350 r.p.m.
Small step on pulley (D) to large step on spindle pulley	3,500 r.p.m.

If our type "E" Cutter Spindle is fitted, the speeds are slightly reduced as follows :—

Large step on pulley (D) to small step on spindle pulley	15,000 r.p.m.
Large step on pulley (D) to large step on spindle pulley	8,750 r.p.m.
Small step on pulley (D) to small step on spindle pulley	5,450 r.p.m.
Small step on pulley (D) to large step on spindle pulley	3,200 r.p.m.

Adjustment for stretch in both belts in provided by means of a stay rod to the cutter spindle and a slotted link which permits adjustment of the driving pulley.

NOTE particularly the following codes for ordering spare belts :—

	Code
Spindle belt for "C" and "CB" models (coloured green and white)	110/279
Motor belt for "C" Model (coloured white)	110/276
Motor belt for "CB" Model (coloured white)	110/278

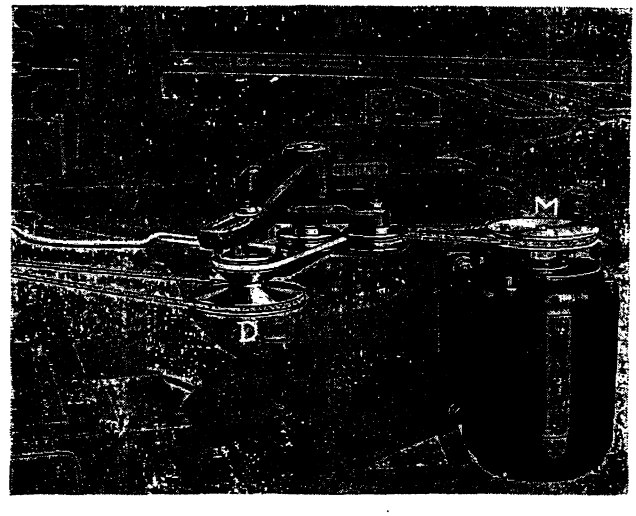


Fig. 6.—Type M3 Compact Drive for "CB" Models.

ERECTING OF MODELS "CX" AND "CXL"

The erecting of these models is somewhat simplified as the machines are shipped attached to their pedestals. The fitting of the head, pantograph and copyholder is carried out exactly as for models "C" and "CB."

The drive is by $\frac{1}{4}$ h.p. motor attached to the pedestal and running at 2,850 r.p.m. The motor is assembled at the works and connected to the switch on the brake rod. A length of rubber covered cable is supplied for connecting to the electric supply.

The earth wire (clearly marked) should be connected to a water pipe or some suitable "earth" to conform to Board of Trade regulations. (If fitted with 3-phase motor, its three wires are, of course, all to be connected to the supply. Customer should "earth" the machine separately.

The correct direction of rotation is given by an arrow engraved on the motor pulley.

The belt is fitted as shown in Fig. 7 for the cutter spindle to revolve clockwise when viewed from above. The same speed range as given for the Compact Drive (with type E spindle) is available.

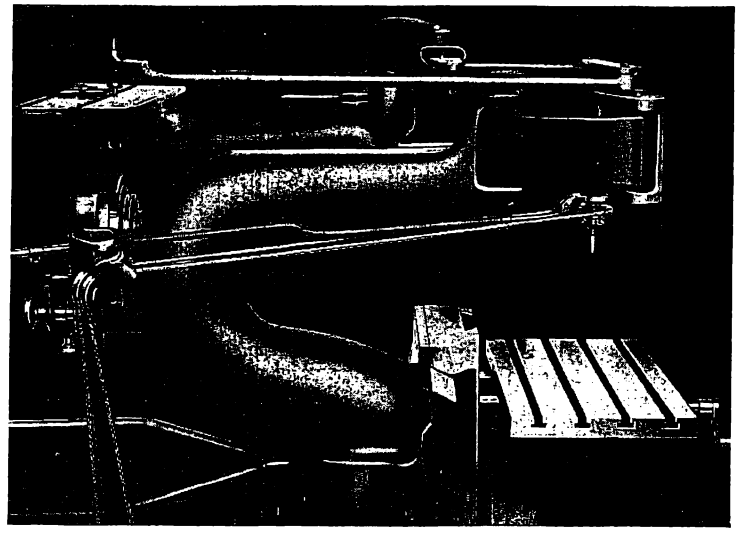


Fig. 7.—"CX" and "CXL" Machine Drive.

Fig. 7 shows how the guide pulleys are fitted on the vertical tube from the motor bracket, also the correct position of the spring loaded stay rod. This stay rod is packed separately and should be attached to the yoke around the cutter spindle by means of the small pin provided. This pin is a push fit and should be pressed into place with a small hand vice or similar tool—do not use a hammer. It is important to see that the spherical ended collar on the stay rod locates in the notches on the guide pulley bracket.

It will be noticed that these guide pulleys swivel about for a choice of two positions, one for driving the cutter spindle and one for driving the grinding attachment.

See separate Instruction Book on cutter grinding with "CX" and "CXL" models.

The brake rod is pushed away from the column *after* switching off, to stop the motor instantly.

Order spare belts by code No. 110/217.

CONSTRUCTION AND ADJUSTMENT

THE CUTTER SPINDLE TYPE "A"

(Normally fitted to "C" and "CB" Models)

The spindle now fitted as standard is of improved ball-bearing construction. This is shown in section in Fig. 8. It will be noticed that a stiff spring is employed to ensure freedom from play under all conditions.

Adjustment for wear in Cutter Frame

The screw (S) enables wear between the spindle and the cutter frame to be taken up. It should be tightened slightly as necessary just to hold the weight of the spindle. Over-tightening will put undue strain on the feed mechanism.

The spindle will run for long periods without attention. All that should be necessary is occasionally to unscrew the sealing cap and reload with a good grade of grease (we use Vacuum Oil Co's Gargoyle BRB Grease). This should be done every three months. It is absolutely essential to exclude dirt and especially chips from the bearings, and for this reason care should be taken that the cap is always kept in place. Don't clamp yoke (30, Fig. 10) too tightly. It may distort spindle.

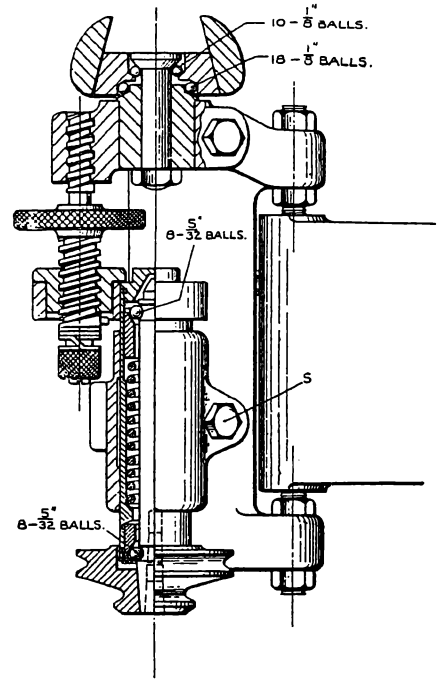


Fig. 8.

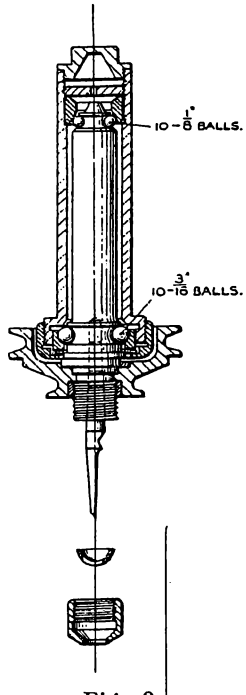


Fig. 9.

THE CUTTER SPINDLE TYPE "E"

(Normally fitted to "CX" and "CXL" Models)

The spindle standardised for these models is of slightly different construction from the one described above—see Fig. 9.

It is self adjusting in the same way and should be lubricated similarly.

When so desired, cutters can be locked in the spindle with a cutter retainer and cap which screws on to the spindle nose. (See illustration).

The cutter is inserted firmly with the cutter wrench in the ordinary way before fitting the retainer and cap.

The cap is given one or two preliminary tightenings before the final one to ensure that the retainer locates correctly.

Order spare cutter retainers by code 110/261.

This type "E" spindle will fit the "C" and "CB" models, but must be ordered specifically for this purpose to ensure the correct form of pulley (see special pamphlet before ordering).

To Remove the Feed Mechanism.

Unclamp the yoke (30) by loosening the screw (38); the spindle may then be withdrawn downwards. Then refer to Fig. 10, slacken the knurled nut (35) and screw the feed screw (32) and the graduated nut (34) up as far as they will go. There should now be enough clearance for the yoke (30) to be slipped out. If there is not sufficient clearance, take out the keep screw (43) at the end of the feed screw and slip off knurled nut (37) and the spring washer. The feed screw assembly may then be removed complete. The yoke must not be forced off or the feed screw may be bent.

When replacing the feed mechanism be careful to see that pin (42) in the sleeve lies between pins (40) and (41) when nut (34) is set at zero. If it has been necessary to remove knurled nut (37) see that the little keep screw (43) is screwed up tightly or it may slack off and get lost. Nut (37) should always be unscrewed for normal working.

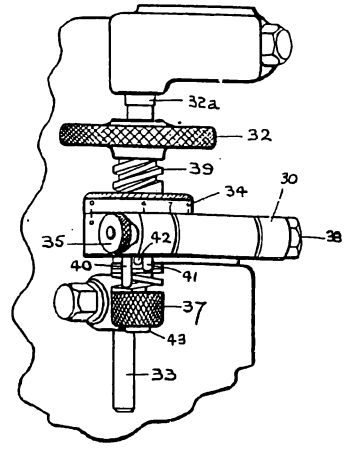


Fig. 10.—Feed Mechanism.

THE PANTOGRAPH

The pantograph and sliders must be kept clean and all bearings should be occasionally oiled with E.M. oil. The three ball-bearing joints will work for long periods without developing any play, but they may, in case of need, be adjusted by tightening up their nuts slightly. Such adjustment should only be made when the pantograph has been removed from the machine so that the play in each individual joint may be felt and the nut tightened *only so far as is necessary just to remove play.* If it is tightened too much the ball races may be damaged.

To Remove the Pantograph

Refer to Fig. 3, then :—

(1). Holding the pantograph arm (L) withdraw the bevel bar (B) from the slider (E) and without releasing the arm (L), lift it, together with bars (B) and (J), away from the loose bar (F).

(2). Withdraw the bar (F) from the slider (H).

THE CUTTER FRAME AND LINK

The cutter frame (Fig. 8), should be so suspended on its centres that the flange on the lower race of the ball-bearing in slider (H) fits against the top facing on the cutter frame without straining the pantograph either up or down.

To Adjust

(1). Remove the pantograph so that the centres can be examined by themselves.

(2). If a joint is loose slacken the nut on the outside of one of the centres and tighten the nut on the inside to draw the centre through its hole.

The centres should be so adjusted that a very slight stiffness can be felt when the links are moved by hand. Both nuts must be left tight. In making this adjustment the height of the cutter frame must be kept as originally set. If it is raised at all the pantograph will not have sufficient room to operate properly.

Shake in the spindle, pantograph joints or cutter frame centres, is generally indicated by bending of the ends of engraved lines as shown in Fig. 24, page 26.

THE WORK TABLE AND SLIDE SCREWS

The screws which actuate the work-table and slide-rest are held in place by slit screwed bushes which are each provided with two holes, one on either side of the slit. Each slide screw has a corresponding hole through it.

To Remove a Slide Screw or to take up end shake

Insert a $\frac{1}{8}$ inch diameter steel rod through the bush hole to your right of the slit and into the hole in the screw ; the two parts will then be locked together and may be unscrewed as one by turning the handle. Be careful to choose the correct hole in the bush so that it tends to close when the screw is turned, otherwise the bush cannot be moved. When replacing the screw, the other hole in the bush must be used.

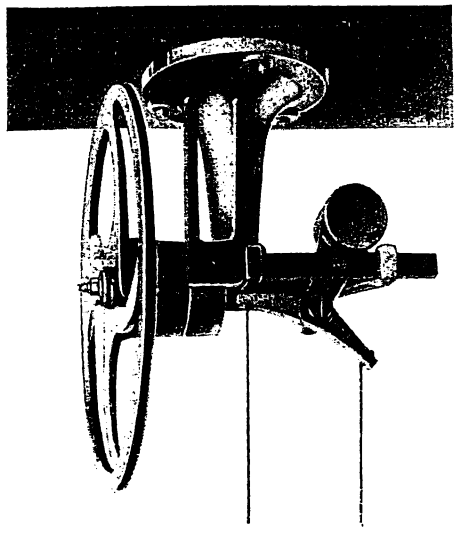


Fig. 11.
Ball Bearing Countershaft.

THE BALL BEARING COUNTERSHAFT

This will require no attention beyond occasional greasing, with the grease gun provided. Any good quality grease such as Gargoyle No. A.3 cup grease will do.

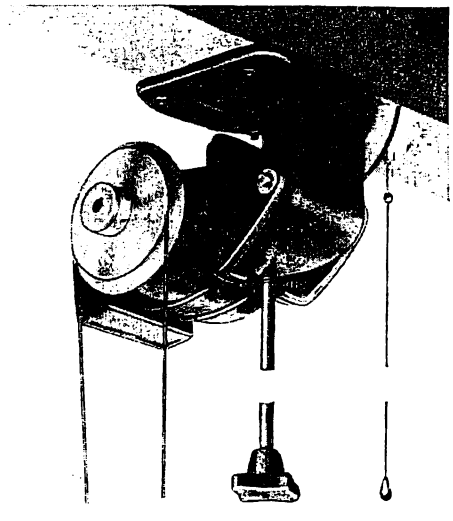


Fig. 12.
Type M1 Ceiling Drive. Bracket and Motor.

MOTORS

For the most part, these have grease packed bearings which need filling occasionally with the grease just mentioned. It is ruinous to flood the bearings with oil.

OPERATING

THE CUTTER FEED MECHANISM

[*The construction of the feed mechanism is shown and described on page* 14].

The Depth of Cut may be regulated in three ways:—

Method 1. By eye. This will, as a rule, be found quite satisfactory for shallow engraving.

Method 2. By means of the adjustable stop (33). This method is effective for deeper cuts, and where the surface of the work is sufficiently level it will ensure uniform depth of cut.

When the feed mechanism is set for use by methods (1) or (2), the following points should be observed:

The graduated nut (34) is clamped in the yoke (30) by the knurled nut (35), and, when it is set to zero, the pin (42) which projects from the screwed sleeve (39) is gripped between the short pin (41) in the bottom of the nut (34) and the longer pin (40) underneath the yoke. Sleeve (39) is now unable to turn, and if the knurled nut (37) is loosened, the feed screw (32a) and feed wheel (32) can be turned easily, to raise or lower the cutter.

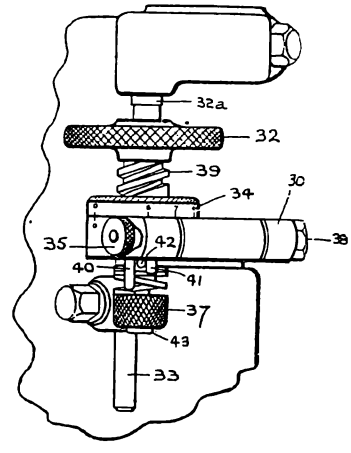


Fig. 10.—Feed Mechanism.

Engraving by method 2.

Lower the cutter until the yoke (30) is against the locked stop (33). Then, with the machine running, raise the work-table by means of its vertical screw until the cutter penetrates to the required depth. Withdraw the cutter by means of the feed wheel (32). The cutter may thereafter be lowered into cut by means of the feed wheel, and the same depth of cut attained. If it is desired to engrave by this method to a known depth, say, .015 inch, a .015 inch feeler gauge is placed on the stop (33), and the cutter fed down until the feeler gauge is trapped between the locked stop and the yoke while the cutter is clear of the work. The work-table is then raised by means of its vertical screw till the cutter just touches the surface of the work. The cutter may now be made to penetrate the desired depth by withdrawing the feeler gauge and feeding the cutter down until interrupted by the stop.

Method 3. By means of the differential screw feed. This is used, especially for work with an uneven surface, such as watches and cigarette cases, to *measure* the depth of cut and to gauge the depth *from the work surface* for each separate character engraved.

Engraving by method 3.

(*a*) Set the mechanism as follows:—To engrave, say, .02 inch deep, loosen knurled nut (35) and set the figure 2 (=.02 inch) on graduated nut (34) opposite index on the yoke. See that the yoke is up against the shoulder of the nut and tighten screw (35) to clamp the nut (34). Tighten knurled nut (37). Nut (34) is graduated in 100ths of an inch.

(*b*) Screw the cutter down till it just touches the surface of the work.

(*c*) Reverse the feed wheel until pin (42) can be felt to come in contact with pin (41). During this motion the cutter will be fed to the desired depth. Further motion in the same direction will withdraw the cutter after the character has been engraved.

To put the differential feed out of action, nut (34) must be returned and clamped at zero and nut (37) slacked off.

THE PANTOGRAPH

The pantograph (see Figs. 2 and 3) controls the horizontal movement of the cutter, causing it to reproduce faithfully, on a reduced scale, the movement of the style. Reductions from 1 : 3 to 1 : 16 are marked on the "C" and "CB" pantographs and from 1 : 2 to 1 : 16 on the "CX" and "CXL" pantographs. Greater reductions can be obtained by special settings.

To avoid confusion, only the reductions commonly used are marked on the bars. To set for other reductions reference should be made to the schedules on pages 30, 31 and 33.

To set for a required Reduction

(1). Slacken the hexagon head screws which clamp the sliders (H) and (E), Fig. 2 ; adjust the sliders to bring their index edges exactly against the near edge of the required graduations on the bevel bars and clamp them in these positions. This must be done accurately or the engraving will be distorted.

(2). Slacken the bolt (M), set the head (P) with the required graduation on its scale opposite the index on the frame, and clamp in position.

For reductions not marked on the pantograph it will generally suffice to set the head to the nearest reduction marked at (R).

To set the Style

Slacken the clamp screw, hold down the style (G, Fig. 2) with its point in the copy, raise the pantograph end $\frac{1}{16}$ inch (not more) and re-clamp. The slight "set" of the pantograph arm thus produced will help to keep the style in the copy, and the pantograph will spring sufficiently to permit the style to be moved from one character to another.

Area covered by Style and Cutter

The area which can be covered by the cutter varies directly with the scale of reduction but the area covered by the style is not greatly affected by changes of the pantograph setting.

The standard copyholders represent generally the largest rectangular figures which can be covered by the style, but it can reach an irregular figure somewhat larger. In the rare cases in which this larger area is useful copies may be held on either the No. 0 copyholder or on a board 1 inch thick and 17 inch x 8 inch attached to the head in place of the standard copyholder. For this purpose the head is drilled for three No. 12 wood screws.

Figs. 25 and 26 show the largest areas which can be covered by the cutter with the various reductions.

Reductions less than 1 : 2

Engraving with reductions less than this is not usually desirable because of lack of leverage to control the cutter movement, but it is sometimes necessary, as in duplicating and making copy.

THE DIRECT COPYING ATTACHMENT

This is a simple and inexpensive device for making engravings exactly the same size as the copy. It is illustrated in Fig. 13, and consists of the part C, which replaces the head of the machine and carries the copyholder, and the curved arm A, which is connected to the cutter-frame and communicates the motion of the style direct to the cutter. This attachment will not operate conveniently with No. 0, No. 2X and No. 5X copyholders.

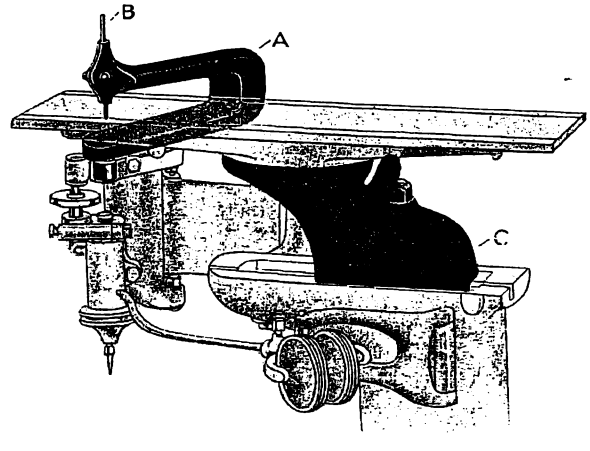


Fig. 13.—The Direct Copying Attachment.

EQUAL PANTOGRAPHS

The "CX" and "CXL" models can be fitted with pantographs operating at ratios between 1 : 1 and 1 : 6. These pantographs are complete with their own special heads and utilise standard copyholders. Areas covered are slightly larger than diagram on pages 28 and 29. Schedule of intermediate reductions is on page 30.

The "C" and "CB" models have a pantograph, complete with special head for operating at ratios between 1 : 1 and 1 : 5.

The copyholder is integral with the head and is of the same dimensions as the worktable (8 inches square) and T slotted similarly. If it is required to hold standard copy with bevelled edges we supply small adapting plates for holding single pieces. The area covered by this pantograph is about the same as diagram on page 32. Being smaller in its scope, the Equal Pantograph is not so generally useful on "C" and "CB" machines as on the larger "CX" and "CXL" models. Special schedule of intermediate reductions is supplied separately.

THE WORK-TABLE

The work-table can be raised, lowered, traversed forwards, backwards, and to right and left by means of three crank handles. When the machine is set up for repetition work it is desirable to clamp the slides so that the table cannot be accidently disturbed. This is done by means of the long screw underneath the table inside the bracket, and the bolt at the back of the lower side.

EXTENSION TABLE FOR LARGE PLATES

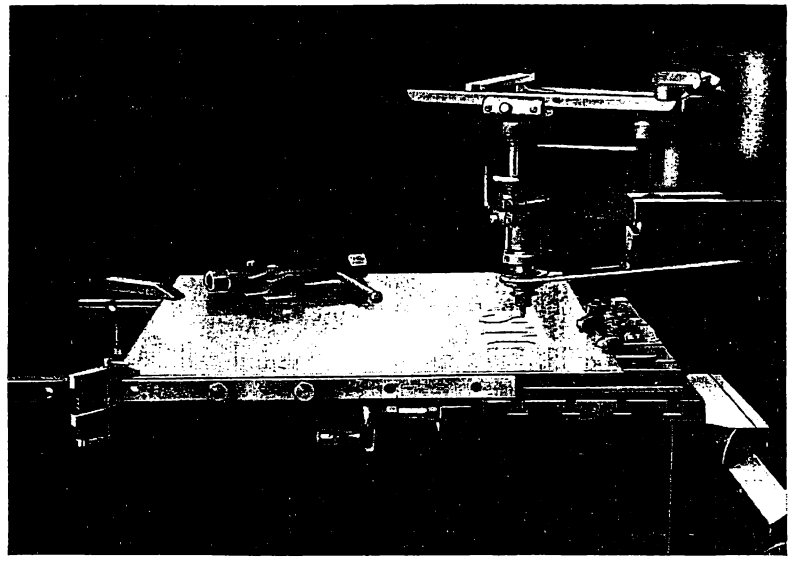


Fig. 14.—Extension Table with extending bars.

For work outside the scope of the ordinary machine tables, we supply an extension table measuring 14 inches x 18 inches x 1 inch, and carrying four T slots lengthwise which take the standard work clamps. This table fits all machines.

As an added convenience for exceptionally large plates, we can supply extending bars and screws for this table. The bars extend in either direction and form convenient surfaces for accommodating extra clamps. Fig 14 shows the table in use with the bars.

THE COPYHOLDER

All copyholders have two bosses which bear against stops on the head (see Fig. 3). The stops are so set at our works that when the copyholder is turned against one of them it is either at right angles to (as shown in Fig. 3) or in line with the work table.

The copyholder may be used in either of these positions or in any intermediate position, but that shown in Fig. 3 is the most favourable for the free action of the pantograph.

Dovetailed slots in the copyholders receive the standard bevelled edge copies, which are secured in place by means of the end-clamps provided.

Copyholders to take standard copy are supplied in the following sizes :—

Copyholders for "C" and "CB" machines. 16 inches long.		Copyholders for "CX" and "CXL" machines			Width of each groove	To take Standard Copies No.
No.	No. of Grooves	No.	Length—Inches	No. of Grooves		
2	3	2X	16	5	$1\frac{1}{4}$ inches	2A, 2C, 2L
3	1	3X	20	1	$3\frac{1}{2}$ inches	3A, 3C
4	1	4X	20	1	$4\frac{1}{2}$ inches	4
5	2	5X	16	3	$2\frac{1}{4}$ inches	5A, 5C, 5L

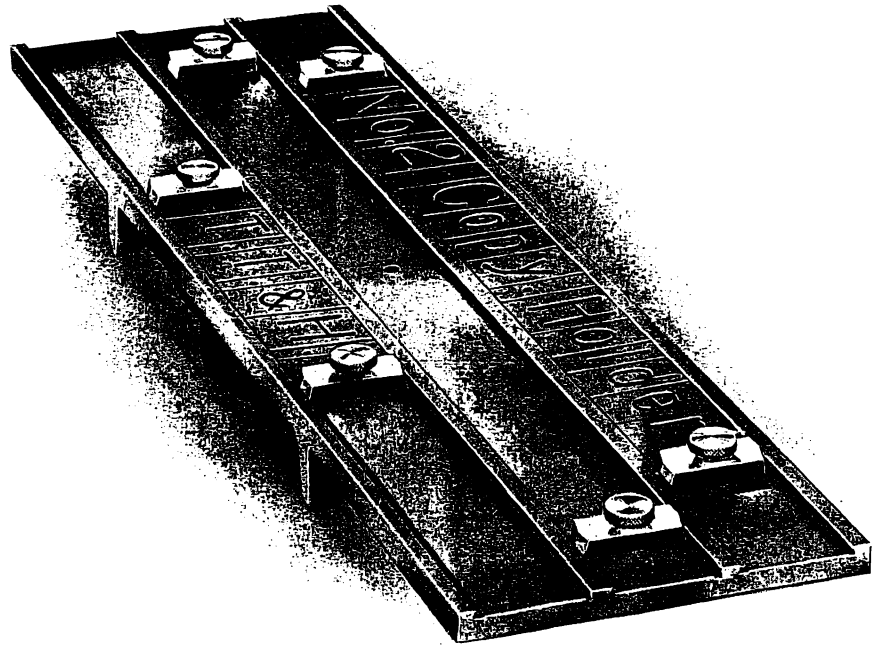


Fig. 15.—No. 2 Copyholder set up with Copy.

We can supply these grooved copyholders fitted with a spring catch for engraving in circular fashion or around cylinders (see page 34). This spring catch locates in notches in the edge of the copy strip against each character and enables the copy to be traversed step by step as the engraving proceeds. The copy style maintains a central position in the copyholder thus keeping the cutter radial over the work.

The catch is fitted with a light spring to "feel" the notches and a heavier spring to grip the copy firmly while engraving. It can be arranged for hand or foot operation.

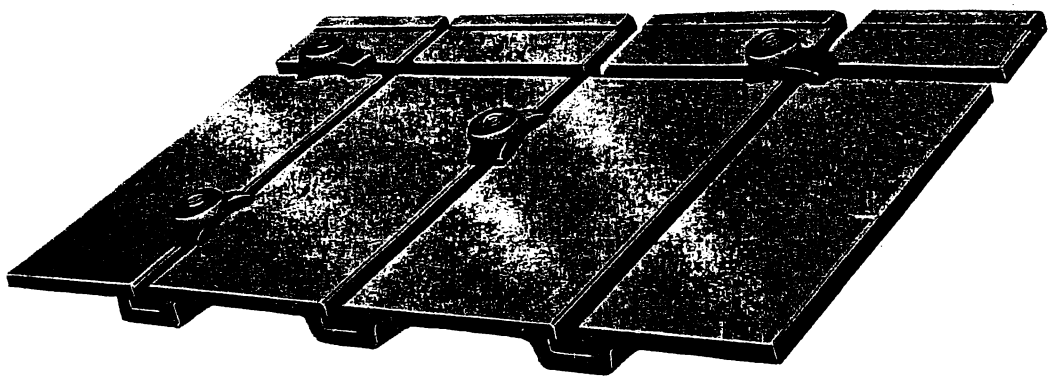


Fig. 16.—No. 0 Copyholder, 16 inches x 9 inches, for special copies.

CIRCULAR COPYHOLDER

This is fitted on the engraving machine head and is movable through 90° like other copyholders. It is used with rotatable disc copies which are notched to engage the spring catch for engraving in circular fashion or around cylinders. (see page 34). It is an alternative to the grooved copyholder fitted with spring catch as described on previous page. The catch is released by depressing the central knob with the palm of the hand.

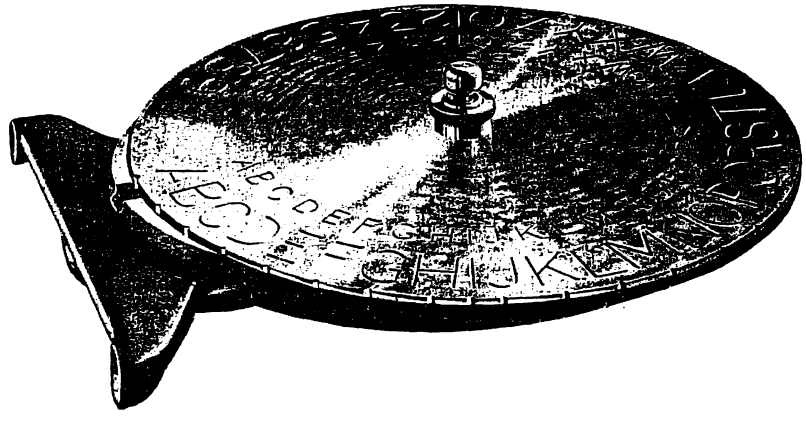


Fig. 17.—Circular Copyholder.

COPY

The function of copy on the engraving machine is to determine accurately the path of the pantograph style, and thereby of the cutter.

Generally, the most useful copy is a metal plate engraved with a V channel or track adapted to fit a style with a 90° conical point which the operator moves along the track. When the style is maintained with a good outline on its point, such copies last for a long time ; and the angular section prevents lateral slackness, even though the copy be worn.

STANDARD LINE COPIES

The standard line copies illustrated on page 22, have been developed with the assistance of leading authorities in type design and have been adopted as Standards for instrument work by H.M. Government and by many private firms.

For general use we recommend the "A" Copy characters. These are simple block capitals having a ratio of height to width of about 3—2.

The "C" copy characters are narrower, the proportions being about 2—1, and are intended to be used only where space is too limited for the bolder "A.. style.

The "L" copy is lower case intended for use with "A" style.

The schedule below gives particulars of the various copies which can be supplied from stock. They are engraved on hard brass strip bevelled to fit one or other of the copyholders listed on page 19.

STANDARD LINE COPY

No.	Height in inches (Centre to centre of line)	DESCRIPTION	For use with Copyholder No.
2A	$\frac{3}{4}$	An assortment of 128 capital letters, figures, stops, etc., with spacings sufficient for all ordinary purposes	2 & 2X
2C	$\frac{3}{4}$	Same assortment as above, but narrower style	2 & 2X
2L	$\frac{1}{2}$	An assortment of 102 lower case letters to combine with No. 2A	2 & 2X
5A	$1\frac{1}{2}$	An assortment of 88 capital letters, figures, stops and spacings ...	5 & 5X
5C	$1\frac{1}{2}$	Same assortment as No. 5A, but narrower style	5 & 5X
5L	1	An assortment of 80 lower case letters to combine with No. 5A	5 & 5X
3A	3	A single set of 41 capital letters, figures, etc.	3 & 3X
3C	3	Same assortment as No. 3A, but narrower style	3 & 3X
4	3	A single set of 68 pieces, capitals and figures the same size as No. 3A together with suitable lower case letters	4 & 4X

Single characters, alphabets or any desired assortment of any of the above characters are supplied on request. Reversed copies as for printing are made to order.

SPECIAL COPY

We have a very large variety of master copies suitable for making working copies and including Roman and other alphabets, reversed lettering, etc., and are always prepared to advise with regard to the design or layout of suitable lettering and to make up special alphabets or set copies to customers' sketches or samples.

Copy No.	Height of Copy	Largest Engraving produced at 1:3 reduction (limit of size of "C" and "CB" models).	Smallest Engraving produced at 1:16 reduction.
2A	$\frac{3}{4}''$	ABCDE 5	ABCDE 5
2L	to match 2A	abcde	abcde
2C	$\frac{3}{4}''$	ABCDE 5	ABCDE 5
5A	$1\frac{1}{2}''$	AB5	ABCDE 5
5L	to match 5A	ab	abcde
5C	$1\frac{1}{2}''$	AB5	ABCDE 5
3A	3″	A5	ABCDE 5
3C	3″	A5	ABCDE 5
No. 4	3″ with lower case to match	ab	abcde

Engraving 50% larger than the above can be produced on "CX" and "CXL" machines with Pantographs operating at 1:2 reduction.

DESIGN AND SPACING OF COPY

Lettering must be designed with considerable judgment and skill if it is to be pleasing in its effect. Individual characters of graceful proportions are not sufficient, they must be designed as a set, due attention being paid to the effect on the eye of various forms and their influence on one another.

Letters and figures which are mathematically uniform are not pleasing in appearance ; this is due to the fact that some forms look larger and some smaller than they really are.

Spacing in order to be right must *look* right. As with printer's type, the blanks upon which standard copy characters are cut are designed to give the best spacing with average combinations of characters. But the margins can only be made to suit the most usual conditions and there will always be certain combinations which appear too crowded.

With uniform spacing, characters with straight vertical sides which come together will always appear cramped. In HIL T for example, the appearance of the engraving can be improved if the H, I and L are spaced out the better to match the irreducible space between the L and the T. To adjust the spacing as above indicated we supply spacers of various widths with all standard copy.

LENGTHY INSCRIPTIONS

It is often necessary to centralize a long line of lettering on a nameplate which requires more characters than the copyholder will hold at one setting, thus making it difficult to get correct positioning and spacing. The best plan in such instances is to set out the complete line of copy on a table, spacing it as indicated above and then to measure the length taken up. The ratio of this length to the space available on the work will give the reduction setting for the pantograph. Furthermore, when measuring the line of copy, if the character which is central, is noted, this can be engraved first on the centre line of the plate, thus positioning all other characters correctly. The remainder of the engraving can then be carried out step by step with just the number of characters in the copyholder which it is convenient to hold.

SIZES OF COPY AND WORK

It is obvious that, by varying the reduction, the same size of engraving may be done from copy of various sizes. For example, characters $\frac{1}{4}$ inch high may be engraved either from $\frac{3}{4}$ inch copy with the 1:3 reduction, from $1\frac{1}{2}$ inch copy with the 1:6 reduction or from 3 inch copy with the 1:12 reduction.

Small copy permits of many characters, perhaps the complete inscription, being set up in the copyholder at once. This is generally an advantage. With large copy the leverage of the pantograph is greater and the operator, having more control over the cutter, moves it more steadily. Moreover the copy is less subject to wear, and slight defects due to wear are proportionally reduced in the engraving.

In the example cited, the $1\frac{1}{2}$ inch copy would give the best combination of compactness, cutter control and durability.

The height of copy is measured from centre to centre of line. The overall height of the characters engraved is, therefore, the height of the copy divided by the reduction used and plus the width of cut. Thus, using the standard 2A copy (.75 inch high) and engraving on the 1:10 reduction with a cut $\frac{1}{100}$ inch wide we get (.75 inch $\div$ 10) + .01 inch = .085 inch.

When using single "Line" copies the engraved characters will look somewhat different from the copies on account of the thickening of the lines due to the width of cut. If too wide a cut is made, the lettering will be spoilt. For example, the little lands in the "a" and "e" will be left too small or even cut away altogether.

Block capitals should in no case have a width of cut exceeding $\frac{1}{3}$ of their overall height. Generally a width of only $\frac{1}{8}$ this height is desirable.

SINGLE LINE COPY

As described on page 23, this is used for the simplest form of engraving. Such engraving is distinguished by the rounded ends of the lines (due to the revolving cutter) and by uniform width of cut and is suitable for the great majority of work where the characters are small.

MULTIPLE LINE COPY—Sunk and Relief

For large characters a varying width of line may be preferred and this can be secured by using "Multiple Line" copy, in which each line of the engraved character is produced from two or more lines side by side on the copy. Characters may be engraved in relief in a similar way, and in each case the copy lines are arranged to insure the complete clearance of the area to be cut away.

STENCIL FORM COPY—Sunk and Relief

Another method is to use stencil form copy, Figs. 18 and 19, in which a cylindrical ended style is moved freehand until the cutter has covered the whole area to be engraved.

Fig. 14, page 18, shows engraving, held on the extension table, being done by this method.

Fig. 18.—Sunk Reverse.

Fig. 19.—Relief.

Engraving from Stencil Form Copy

Whereas in line engraving a conical pointed style is used, and the thickness of line engraved may be varied within limits by varying the size of the cutter, in the case of engraving with stencil form copy—either sunk or relief characters, it is necessary, in order to preserve the proportions of the design, that the diameter of the style should be strictly related to the diameter of the cutter, according to the ratio of reduction to which the pantograph is set. With this object, the style and rollers, Fig. 20, are supplied. These rollers furnish, in effect a series of styles varying in diameters from .1 inch to .8 inch by steps of .1 inch.

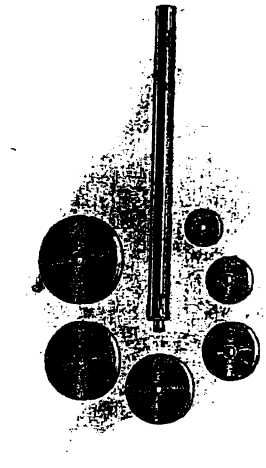


Fig. 20.

In engraving characters which commonly include both large and narrow spaces, besides sharp corners, it is practicable to use a large cutter to clear the large spaces, and a small cutter, with a correspondingly small style, for the smaller spaces and sharp angles.

For light work such as cutting the lettering on type wheels, cutters less than .01 inch diameter can be used. Cylindrical cutters of this diameter are too liable to be broken, and to obtain sufficient stiffness a cutter ground to about 30° cone is generally used. For such fine work the rollers are sometimes too large and special cylindrical styles ground to suitable diameters are then used. Round corners on the outside of sunk and on the inside of relief characters are distinctive features of Engraving Machine work.

Use of Style Rollers

In order that the engraving shall conform to the copy the following precautions must be observed:—

If the cutter is cylindrical, the ratio of its diameter to the diameter of the style roller must equal the reduction in use. Thus—the 1:10 reduction and a .50 inch diameter roller call for a cutter .05 inch diameter.

If the cutter is conical, the same remarks apply, the diameter of the cutter being measured at the surface of the work, when the cut is the correct depth. If the engraving is in a moulding die it is the diameter of the cutter at the bottom of the cut which would be proportionate to the style diameter, seeing that this would be the surface of the lettering on the finished product.

Fixing the correct diameter of a conical cutter is simple. The cutter is ground with a clearance as indicated in figure 32, to a smaller diameter at the end than is calculated. A trial cut is taken, which, of course will leave a raised character of too wide a face or a sunk character of too narrow a face. The end of the cutter can then be truncated as required to bring the face width of the engraving correct (see pages 36 to 40 on the grinding of cutters).

With a parallel cutter the diameter must be determined precisely before any cut is taken. This diameter cannot be measured on the sharpened cutter itself since the cutting edge is more prominent than the part relieved (see Fig. 32). A convenient method of testing is as follows :—

Grind the cutter as nearly to size as can be measured or judged, the required style being on the pantograph. Set the style as in Fig. 21, against any straight fence or shoulder such as "O," which may be a strip of metal clamped to a copyholder. Fix any piece of metal on the work table, and feed the cutter so that it penetrates this metal to the required depth of cut. Withdraw the cutter. Without moving the style, set some square-ended piece of metal, such as a rule P against one side of it, and move the style away. Set a second rule or the like "Q" against the end of "P," and take away "P"; then bring the style into position against "Q" and the fence "O." Now feed the cutter again into the work, and if the two holes produced by the cutter just touch one another, the cutter is of right size for that style and reduction. If not, it must be corrected by grinding, or a suitable style chosen.

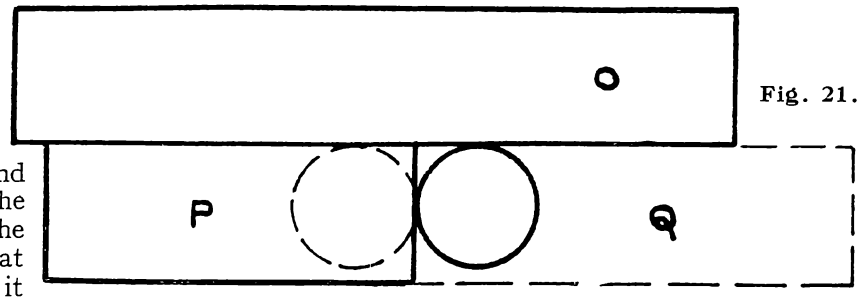


Fig. 21.

Microscope for Checking Cutters

The most satisfactory means of checking cutter diameters is by means of a microscope (see below).

Fig. 22.

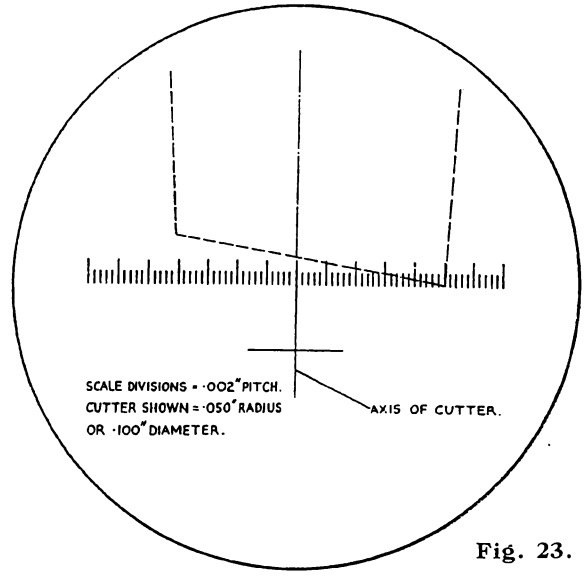


Fig. 23.

Accurate measurement depends on the cutter axis being exactly on the centre line of the graticule. Adjustment for centering in this way is provided and a check can be made at any time by grinding a *truly circular* point on a cutter.

With this method one can guarantee to duplicate cutter sizes and shapes without the necessity for making trial cuts. We supply a suitable microscope with a graticule graduated in units of .002 inch. Fig. 22 shows the microscope with a cutter in position. Fig. 23 indicates how the diameter is checked by the graticule while the cutter is still in the grinding socket. Special graticules for checking angles etc., can be supplied to order.

Controlling the Cutter

When any revolving cutter is fed into its work at the beginning of a line as at "A" in Fig. 24, it has no lateral displacement but as soon as it is traversed it tends to move to one side of its proper course. In the case of the engraving cutter, rotating clockwise, this tendency is to the left of its line of advance.

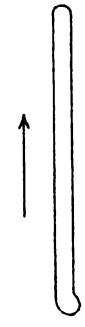


Fig. 24.

Whether the displacement is perceptible or not depends upon the heaviness of cut and on the degree of freedom in the machine joints.

In cutting the outlines of raised characters it is generally desirable to take roughing cuts going clockwise externally, and anti-clockwise internally, round each character and to take finishing cuts in the reverse direction. By this procedure the cutter while roughing is prevented from overcutting the character and a slight surplus of material is left for the finishing cut. The finishing cut also leaves a better surface when traversed in this direction. In engraving the outlines of sunk characters the directions of traverse should be opposite to those above stated.

SET COPIES

Where any inscription is to be engraved over and over again, for example a firm's name or trade mark, the copy should be engraved on one plate, as "Set" copy.

We have special facilities for making set copies to customers' requirements, and we supply accurately bevelled metal strip on which customers can engrave copies.

Well-designed set copies save time and give a finish and uniformity to work which is not obtainable by means of loose characters.

Set copies are sometimes used in conjunction with loose characters. For example, inscription plates for electro-motors, machine tools, etc., may have to be engraved with progressive serial numbers, in addition to a repeated inscription. In such cases a set copy carries the repeated matter and is provided with slots in which the serial numbers can be built up with standard copy figures.

In the case of inscriptions too large to be engraved at one setting, the set copy may be in two or more parts ; and to insure engraving these in correct relation the copies and the work holders may be provided with registers such that at each re-setting the copy and work will be located in the correct relative positions.

Where the expense of such provision is not justified, the set copies may be made to overlap so that after a change of copy the work may be placed correctly by setting the style in the overlapping part of the copy and setting the engraved portion of the work correspondingly under the cutter.

Set copies too large for standard copyholders may be adapted by mounting them on standard bevelled strip. Alternatively they may be held on the No. 0 Copyholder (Fig. 16, page 20), which measures 16 inches x 9 inches and is provided with a fence for locating the copy squarely.

For circular set copy see page 34.

BUILT-UP SET COPIES

Copies may sometimes be made by using standard copy characters stuck down with wax (80% rosin or colophony and 20% beeswax) to a foundation of wood or stiff card. The bracket on the head of the machine which carries the standard copyholders is provided with three screw holes which make it easy to mount such temporary copies.

TEMPORARY COPIES IN CELLULOID

Temporary copies are very conveniently made from transparent celluloid about $\frac{1}{32}$ inch thick. Such copies are cheap to make and with care can be used about thirty to one hundred times.

The copy is made direct from the drawing by placing the celluloid over it and tracing the diagram with a steel scriber ; a straight edge and french curves may be used as guides.

A cut of from $1\frac{1}{2}$ to 2-hundredths of an inch deep is quite sufficient to guide the style.

Line copy may be cut with a special graver designed by us for the purpose and which we supply on request.

Stencil form copy for sunk or relief engraving may be made as above by scribing the lines deeply and breaking the celluloid along the lines. The point of a knife may be used instead of a scriber.

Celluloid copies should be tacked down to wood or stout card in order to protect them and to hold them out flat. Shoe tacks (Swedes) should be used and they should be placed close to the cut or the edge, as the case may be, so that there will be no tendency for the copy to lift and become distorted.

It is advisable to hammer the tacks in about two-thirds of their length only, then to cut off the heads with a pair of side cutting pliers. This avoids any tendency to split the celluloid. The tack stumps are hammered flush with the surface to avoid injuring the operator.

Where dies or moulds are required to be engraved with reversed characters and where reversed copy is not available, an ordinary copy and copyholder may be packed upside down above the style to effect the necessary reversal.

MATERIAL FOR COPY

Hard-rolled brass of 16 Imperial Wire Gauge has proved to be the best all round material in which to cut permanent copies. Copies of hardened steel have a longer life but their first cost is considerably more and there are difficulties in hardening long set copies without warping.

We can supply the following copy material from stock :

(1) No. 16 gauge ($\frac{1}{16}$ inch) sheet brass.
(2) Accurately bevelled brass strip made to fit standard copyholders.
(3) Transparent celluloid sheet about $\frac{1}{32}$ inch thick.

CARE OF COPY

Copies should be kept free from grit, and should be slightly oiled from time to time. Line copies will last a very long time if the style is kept ground to the proper angle. Styles are much cheaper than copy, and frequent grinding will pay well in the long run.

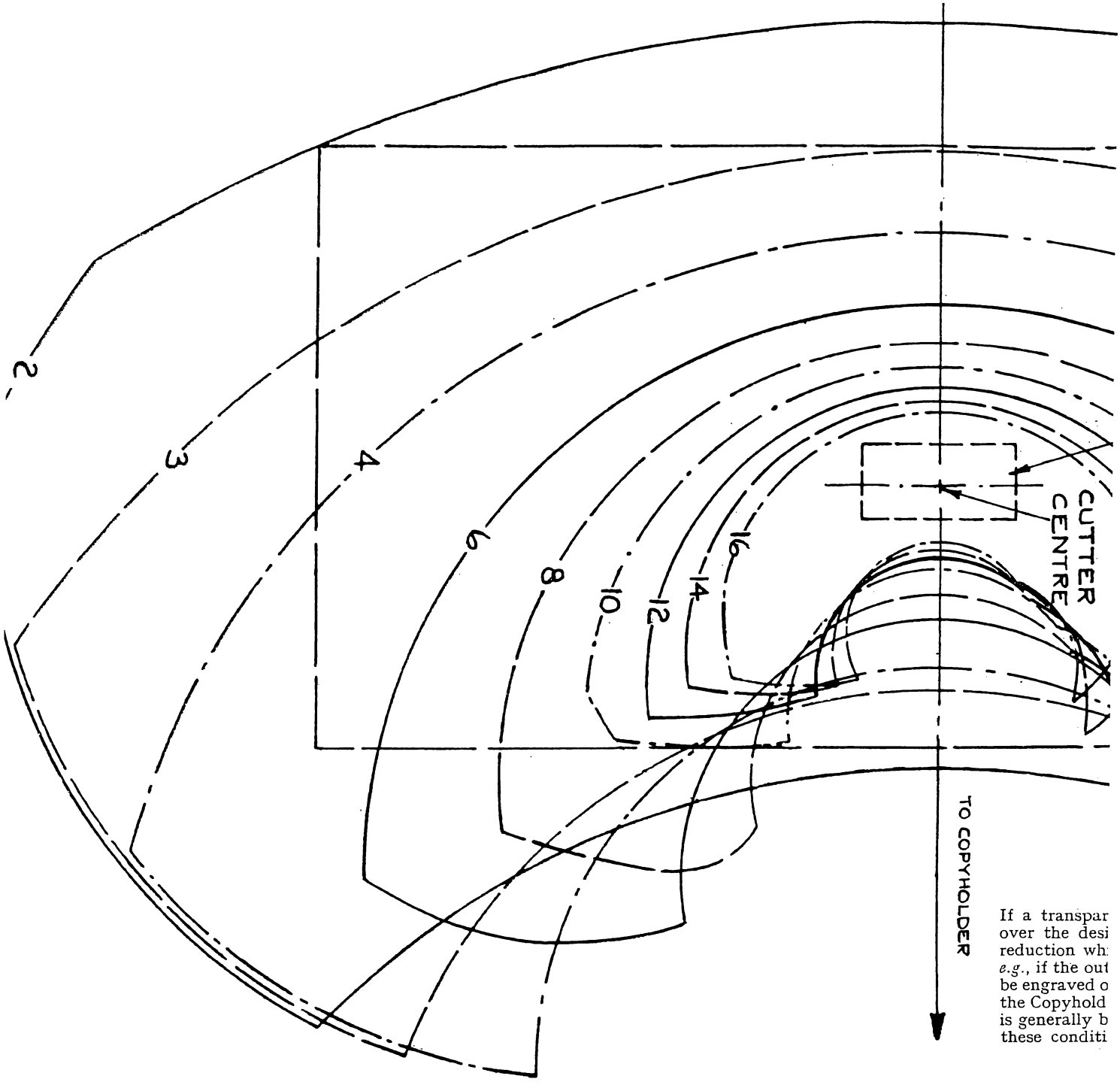
GRINDING THE PANTOGRAPH STYLE FOR LINE COPY

Grind the style as the cutter is ground (see page 37), using the little stop collar (supplied with the machine) to locate it endwise in the "V" of the grinding arm. It should be ground accurately at 90° to fit the groove in the stop collar, and the sharp point slightly blunted on the oil stone.

A convenient check on the accuracy of the angle is to hold the style inclined at 45° and look past it squarely at a window frame, matching the angle of the style cone with the angle of the frame.

TAYLOR-HOBSON "CX" ANI

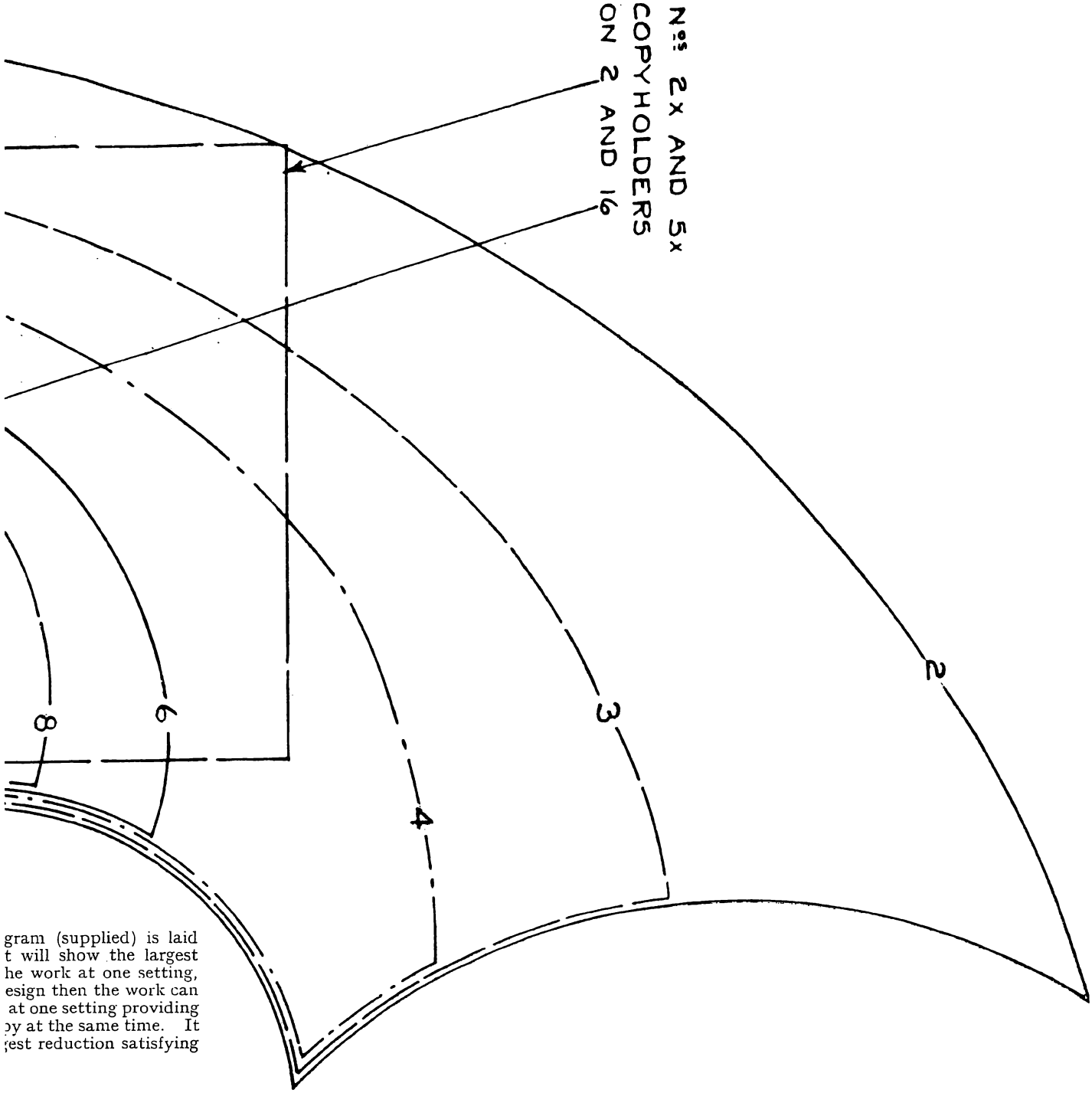
Areas covered by Cutter



If a transpar
over the desi
reduction wh
e.g., if the out
be engraved o
the Copyhold
is generally b
these conditi

ENGRAVING MACHINES

2 to 1:16 pantograph



gram (supplied) is laid
t will show the largest
he work at one setting,
esign then the work can
at one setting providing
by at the same time. It
;est reduction satisfying

SCHEDULE OF INTERMEDIATE REDUCTIONS FOR "CX" AND "CXL" MODELS FITTED WITH 1:1 TO 1:6 PANTOGRAPH

By means of the following table, the pantograph can be set for reductions not marked on the bars.

The figures given are the distances in inches to which the sliders must be set from the lines indicating the 1:1 setting. This can be done with sufficient accuracy by means of the magnifier and rule provided. The rule is graduated in 50ths of an inch.

The head should be set to the nearest reduction marked at R (Fig. 2).

Reduction	Long Bar	Short Bar	Reduction	Long Bar	Short Bar	Reduction	Long Bar	Short Bar
1:1.1	1.09	.18	2.7	7.56	1.72	4.4	9.27	2.35
1.2	2.00	.34	2.8	7.71	1.77	4.5	9.33	2.38
1.3	2.77	.49	2.9	7.86	1.82	4.6	9.39	2.40
1.4	3.43	.62	3.1	8.13	1.91	4.7	9.45	2.42
1.5	4.00	.75	3.2	8.25	1.96	4.8	9.50	2.45
1.6	4.50	.86	3.3	8.36	2.00	4.9	9.55	2.47
1.7	4.94	.97	3.4	8.47	2.04	5.1	9.65	2.51
1.8	5.33	1.07	3.5	8.57	2.07	5.2	9.69	2.53
1.9	5.68	1.16	3.6	8.67	2.11	5.3	9.74	2.55
2.1	6.29	1.33	3.7	8.76	2.14	5.4	9.78	2.57
2.2	6.55	1.40	3.8	8.84	2.18	5.5	9.82	2.58
2.3	6.78	1.47	3.9	8.92	2.21	5.6	9.86	2.60
2.4	7.00	1.54	4.1	9.07	2.27	5.7	9.89	2.62
2.5	7.20	1.60	4.2	9.14	2.29	5.8	9.93	2.64
2.6	7.38	1.66	4.3	9.21	2.32	5.9	9.97	2.65

Example :—Reduction required 1:4.5. Set the index edge of slider on the long bar 9.33 inches from the line marked 1 on the bar and the slider on the short bar 2.38 inches on the line 1 on its bar.

SCHEDULE OF INTERMEDIATE REDUCTIONS FOR "CX" AND "CXL" MODELS FITTED WITH 1:2 TO 1:16 PANTOGRAPH

By means of the following table, the pantograph can be set for reductions not marked on the bars.

The figures given are the distances in inches to which the sliders must be set from the lines indicating the 1:2 reduction. This can be done with sufficient accuracy by means of the magnifier and rule provided. The rule is graduated in 50ths of an inch.

The head should be set to the nearest reduction marked at R (Fig. 2).

Reduction	Long Bar	Short Bar	Reduction	Long Bar	Short Bar	Reduction	Long Bar	Short Bar
1:2.1	.38	.08	4.8	4.66	1.20	7.8	5.94	1.64
2.2	.73	.15	4.9	4.73	1.22	8.2	6.04	1.68
2.3	1.04	.23	5.0	4.79	1.24	8.4	6.09	1.69
2.4	1.33	.29	5.1	4.86	1.26	8.6	6.13	1.71
2.5	1.60	.35	5.2	4.92	1.28	8.8	6.17	1.73
2.6	1.85	.42	5.3	4.97	1.30	9.0	6.21	1.74
2.7	2.07	.47	5.4	5.03	1.32	9.25	6.26	1.76
2.8	2.28	.52	5.5	5.08	1.34	9.5	6.31	1.78
2.9	2.47	.57	5.6	5.14	1.36	9.75	6.35	1.80
3.1	2.84	.67	5.7	5.18	1.37	10.5	6.47	1.84
3.2	3.00	.71	5.8	5.23	1.39	11.0	6.54	1.87
3.3	3.15	.75	5.9	5.28	1.41	11.5	6.60	1.89
3.4	3.28	.79	6.1	5.37	1.44	12.5	6.71	1.94
3.5	3.42	.83	6.2	5.41	1.45	13.0	6.76	1.96
3.6	3.55	.87	6.3	5.45	1.47	13.5	6.81	1.97
3.7	3.67	.90	6.4	5.49	1.48	14.5	6.89	2.01
3.8	3.78	.93	6.5	5.53	1.49	15.0	6.93	2.02
3.9	3.89	.97	6.6	5.57	1.51	15.5	6.96	2.04
4.1	4.09	1.02	6.7	5.60	1.52	18.0	7.10	2.10
4.2	4.18	1.05	6.8	5.64	1.53	20.0	7.19	2.13
4.3	4.27	1.08	6.9	5.67	1.54	22.0	7.26	2.17
4.4	4.36	1.11	7.0	5.71	1.56	24.0	7.32	2.19
4.5	4.44	1.13	7.2	5.77	1.58	26.0	7.38	2.21
4.6	4.52	1.16	7.4	5.83	1.60	28.0	7.42	2.23
4.7	4.59	1.18	7.6	5.89	1.62	30.0	7.46	2.25

Example :—Reduction required 1 : 4.1. Set the index edge of slider on the long bar 4.09 inches from the line marked 2 on the bar and the slider on the short bar 1.02 inches from the line 2 on its bar.

(32 is Blank)

SCHEDULE OF INTERMEDIATE REDUCTIONS FOR "C" AND "CB" MODELS

By means of the following table, the pantograph can be set for reductions not marked on the bars.

The figures given are the distances in inches to which the sliders must be set from the lines indicating the 1 : 3 reduction. This can be done with sufficient accuracy by means of the magnifier, and a rule graduated in 50ths of an inch, both of which are provided.

The head should be set to the nearest reduction marked at R (Fig. 2).

Reduction	Long Bar	Short Bar	Reduction	Long Bar	Short Bar	Reduction	Long Bar	Short Bar
1: 3.0	.0	.0	5.5	2.42	.53	9.0	3.55	.82
3.1	.17	.03	5.6	2.47	.54	9.25	3.6	.84
3.2	.33	.06	5.7	2.52	.55	9.5	3.65	.85
3.3	.48	.09	5.8	2.57	.57	9.75	3.69	.86
3.4	.63	.125	5.9	2.62	.58	10.0	3.73	.87
3.5	.76	.15	6.0	2.67	.59	10.5	3.81	.89
3.6	.88	.18	6.1	2.71	.6	11.0	3.88	.91
3.7	1.01	.2	6.2	2.75	.61	11.5	3.94	. 93
3.8	1.12	.23	6.3	2.79	.62	12.0	4.0	.95
3.9	1.23	.25	6.4	2.83	.63	12.5	4.05	.97
4.0	1.33	.27	6.5	2.87	.64	13.0	4.1	.98
4.1	1.43	.29	6.6	2.91	.65	13.5	4.15	1.0
4.2	1.52	.32	6.7	2.95	.66	14.0	4.19	1.01
4.3	1.61	.34	6.8	2.98	.67	14.5	4.23	1.02
4.4	1.69	.36	6.9	3.01	.68	15.0	4.27	1.03
4.5	1.77	.37	7.0	3.05	.69	15.5	4.3	1.04
4.6	1.85	.39	7.2	3.11	.7	16.0	4.33	1.05
4.7	1.93	.41	7.4	3.17	.72	18.0	4.44	1.08
4.8	2.0	.42	7.6	3.23	.73	20.0	4.53	1.11
4.9	2.07	.44	7.8	3.28	.75	22.0	4.61	1.13
5.0	2.13	.46	8.0	3.33	.76	24.0	4.67	1.15
5.1	2.19	.47	8.2	3.38	.77	26.0	4.72	1.17
5.2	2.25	.49	8.4	3.43	.79	28.0	4.76	1.19
5.3	2.31	.5	8.6	3.47	.8	30.0	4.8	1.2
5.4	2.37	.51	8.8	3.51	.81	—	—	—

Example :—Reduction required 1 : 6.5 Set the index edge of slider on the long bar 2.87 inches from the line marked 3 on the bar and the slider on the short bar .64 inch from the line 3 on its bar.

CIRCULAR ENGRAVING

Engraving falls naturally into three classes :—

(1). In straight lines on flat surfaces or *along* cylinders. This is done from standard or set copies held in standard copyholders and requires no special equipment.

(2). In curved lines from curved set copy.

Set copy *must* be used for engraving on curves which are not circular, and *should* be used for circular curves where the amount of work to be done justifies the outlay. Curved copies for temporary use may be made by mounting separate copy characters with wax on pieces of ply-wood or cardboard. See paragraph below on the "balancing" of unsymmetrical characters.

(3). In circular curves or around circular surfaces from Copy moved with the work, step by step. This may be done on the dividing head, described and shewn hereunder, used in conjunction with the circular copyholder or with loose or set copy mounted in a standard copyholder. For circular engraving on flat faces the 12 inch circular table may be used.

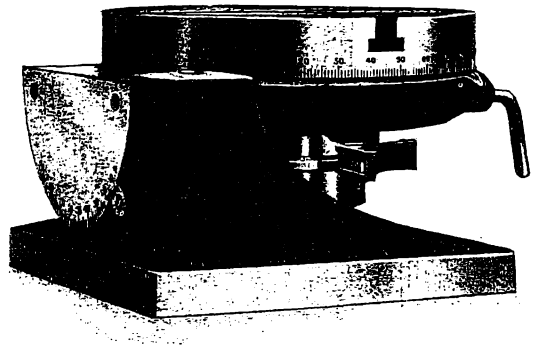


Fig. 27.

THE DIVIDING HEAD

This patented attachment is used to hold and rotate circular work such as discs, cones or cylinders, to present successive portions to the action of the engraving cutter. It is useful also as an attachment to other machine tools.

It comprises a rotatable face plate, 6 inches in diameter having T slots and a central $\frac{3}{4}$ inch hole by which work or special fixtures may be attached, The hole is accurately formed to carry plugs for centering the work. The edge of the face plate is graduated in degrees and the plate can be locked in any position of rotation. A graduated swivel enables the axis of the faceplate to be set at any angle from vertical to horizontal.

The attachment is fastened to the Engraving Machine table by means of two dogs and may be set squarely thereon by the machined edges of its base.

When using this attachment for engraving around circular or conical or cylindrical work, it is necessary to rotate the work step by step and to bring the copy characters in turn to one position on the copyholder. This position should generally be above the centre hole or zero of the copyholder.

Dividers

Accurate steel division plates (dividers) engaging a hardened steel pawl may be used for dividing the circle quickly. These dividers are interchangeable and are supplied plain or with any of the following numbers of divisions : 12, 72, 90, 120, 180 and 360, or with irregular spacings if ordered specially. Dividers are guaranteed to be within + or — $1\frac{1}{2}$ minutes of arc.

Fig. 28 shows the dividing head, with a divider attached, set for the engraving of conical work.

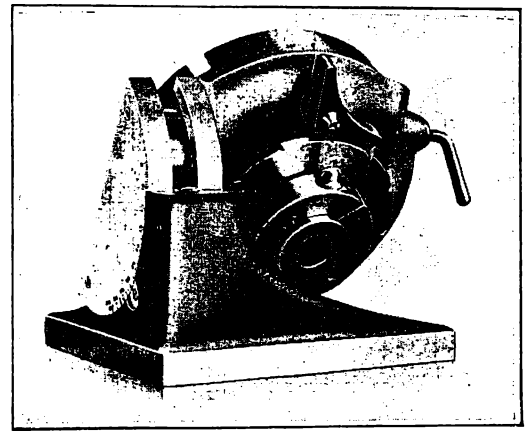


Fig. 28.

Balancing the Characters

In engraving curved lines of characters on the flat or on shallow cones, the "balance" of the

characters requires attention. Thus, if unbalanced characters like L and J are set with their centres radial to the centre of the curve, they will appear to be falling over as compared with symmetrical characters such as A and O. To correct this it is necessary to displace the unbalanced characters; in the case of the L, for example, its vertical line should be nearly radial.

When copy is to be used regularly for work on the dividing head it is desirable to mark on each character a zero which when set radially gives the right effect. To facilitate bringing each copy character to this zero we recommend notching one edge of the copy at its zero and holding it in our straight copyholder with spring catch (see page 19) to engage the notch. Alternatively, the circular copyholder (see page 20), taking nearly 30 inches of copy, may be used.

Spacing the Characters on Circular Work

The inscription should be set out in a copyholder in the ordinary way, the letters being spaced to give the most pleasing effect. The first character is then engraved from a copy character set to the zero position on the copyholder. The next copy character is then brought to zero, the style remaining in the one just engraved, and the work is rotated until the cutter is over the corresponding point in the character just engraved. By this means the spacing of the copy is reproduced accurately.

Where a large number of similar articles are to be engraved in the same way, the copy characters must have zero notches as described above, and a divider carrying notches (one for each character) may be used to position the work rapidly and accurately. Where the quantity does not warrant this course, the divider may be marked with pencil lines to set against the pawl.

Eccentric Work

When working with the dividing head on objects of which the surfaces are not truly concentric with the axis of rotation, a uniform depth of cut may be obtained by the use of the differential feed described on page 16.

THE 12-inch CIRCULAR TABLE

This may be more convenient for circular engraving on flat work as it is larger in diameter than the dividing head. Fig. 29 shows it clamped on to the table of a Model "C" machine.

The clamp screws engage with two raised lugs under the machine table. Avoid over-tightening and thus distorting the table.

As the "CX" and "CXL" models have longer tables without these lugs, it is necessary to order a special plate for this attachment.

A true centre hole is provided for centering the work as on the dividing head.

The spacing of the engraving is carried out as already described.

The table is graduated around its circumference in degrees and is rotated by a worm, one half turn of which corresponds to one degree. An index wheel on the worm is graduated in minutes.

Special Curved Work

For engraving continuous designs round rollers and for other special operations on curved surfaces see pages 46-49.

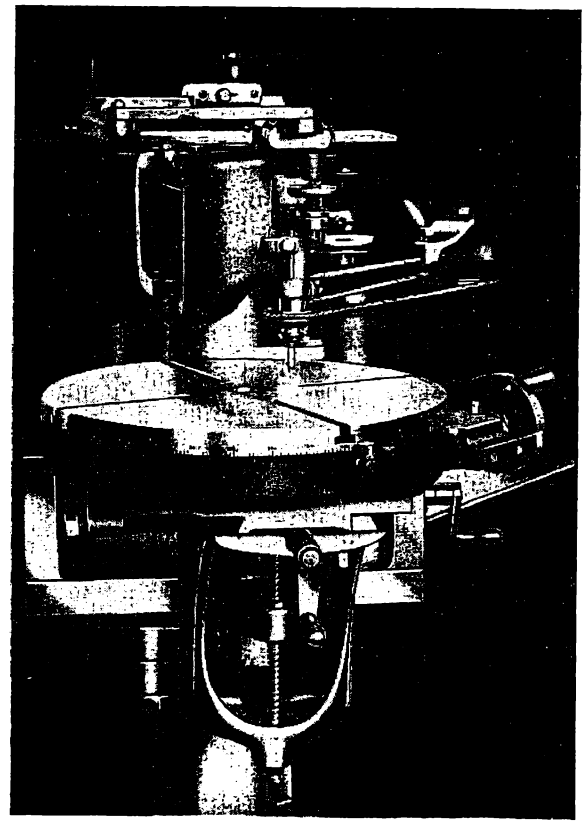


Fig. 29.—12-inch Table on "C" Machine.

CUTTERS

Cutter shanks and the hole in the spindle must be kept scrupulously clean and cutters must always be wrung in with the wrench. If this is done, and if the spindle bearings and cutter-frame joints are free from play, there will be no risk of the cutter working loose except perhaps under heavy side pressure. In such circumstances, the type "E" spindle, see page 13, should be employed.

A wooden scraper is provided to clean the cutter spindle socket and the grinding socket.

The cutter shanks are ground to very fine limits and subjected to rigorous inspection. We guarantee them to fit the spindles as sent out by us but we will accept no responsibility for trouble caused by ill-fitting cutters made elsewhere.

Do not continue to work with a cutter which comes loose, or the hole in the spindle will be worn bell-mouthed so that no cutter will hold properly.

Before a cutter is inserted in the spindle its shank should be wiped clean. If a chip lodges in the spindle hole it will generally mark a ring on the cutter shank and thereby may be located. It must be wiped or scraped out before proceeding.

Cutters are made in four brands of steel, plain carbon steel for softer metals like brass, etc., Talycut steel which has a much longer life, for similar materials, Talyspeed steel for cast iron, tool and die steels, etc., and Speedicut steel for stainless steels.

For prices and sizes of types stocked, refer to special cutter pamphlet.

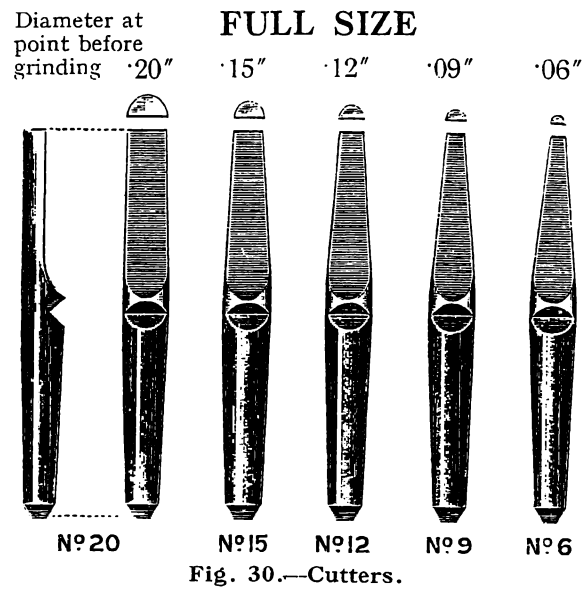


Fig. 30.—Cutters.

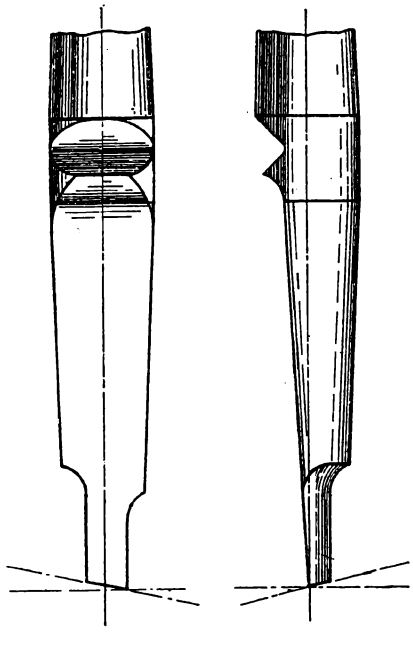


Fig. 31.

Cutters are normally supplied unsharpened, but may be obtained sharpened to any desired form to order. They are known as RIGIFLAT and AXIFLAT (see page 39).

The form of cutter to be used will depend on the class of work and material to be engraved. For lettering not to be filled, a point ground at 90° as illustrated in Fig. 36 is suitable, as a clean cut is produced with no burr. If the lettering is small, the cutting edge extends practically to a point. As the lettering increases in size, it is necessary to grind off this point to produce a flat at the bottom of the cut.

When engraving is to be filled the angle of the cutter is made more acute being about 30° (15° to the axis).

For relief or sunk engraving (see page 24) or for end milling operations, it may be necessary to use a cutter which is quite parallel, *i.e.*, ground cylindrically with the end backed off in both directions as shown in Fig. 31. It is advisable to avoid using parallel cutters as much as possible owing to the tendency to throw up burrs.

In this connection it should be borne in mind that when ordering material for engraved plates it should be specified as "free cutting" to avoid trouble with burrs.

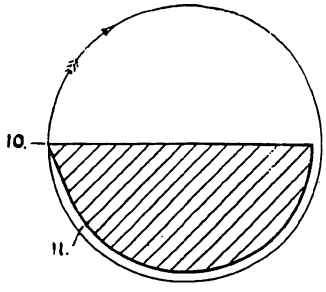


Fig. 32.

All cutters should revolve in the direction which is "Clock-wise" when viewed from above ; and the edge which does the work of cutting, as the cutter is moved laterally, should be "backed off" as shown in the section Fig. 32 at (10), that is, it should be more prominent than the curved back (11) of the cutter.

We have issued a special booklet entitled "Cutter Grinding for Taylor-Hobson Engraving Machines". It deals primarily with our type "D", "CX" and "CXL" pattern grinders, but contains valuable information for all machine users in more detail than is given here. A copy will be sent free on request.

GRINDING CUTTERS

To grind cutters with the attachment provided with the "C" and "CB" models, proceed in accordance with the following instructions :—

Make the pantograph secure against displacement by inserting between the style and the copy-holder a piece of cork or soft wood.

Fix the grinding wheel (12) in the cutter spindle in place of the cutter, putting the cutter to be ground (13) in the grinding attachment socket (14). Run the spindle at a speed of 6,000/7,000 r.p.m. To exceed this is DANGEROUS.

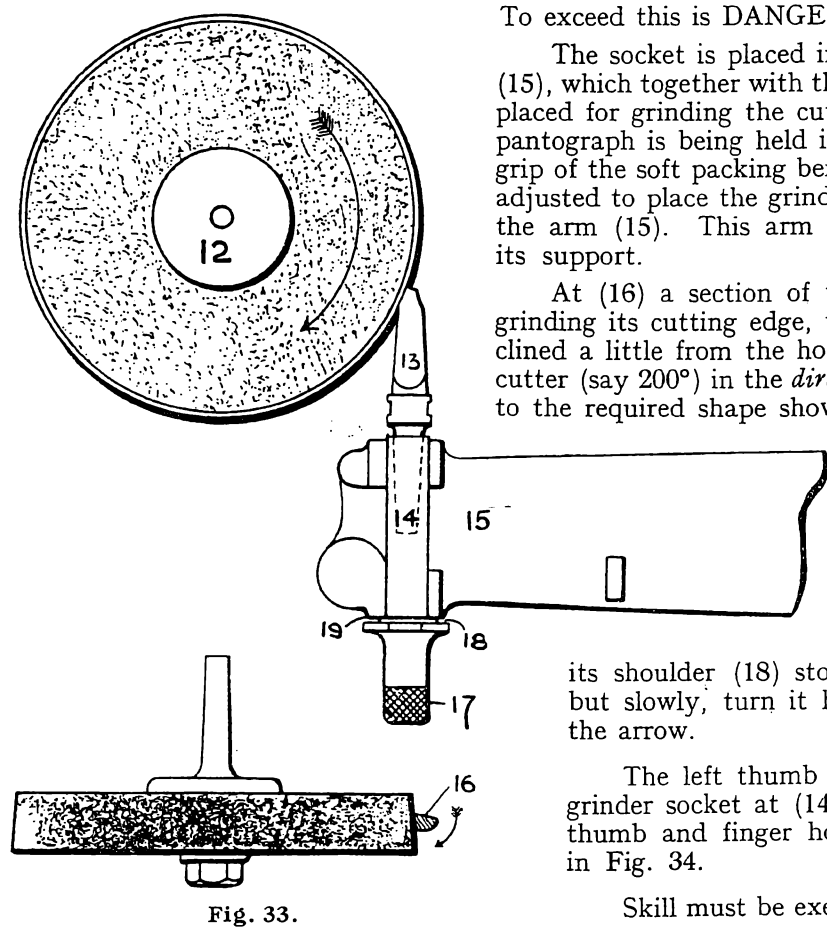


Fig. 33.

The socket is placed in the groove at the end of the arm (15), which together with the grinding wheel, should be suitably placed for grinding the cutter to the required shape. As the pantograph is being held in position by means of the friction grip of the soft packing beneath the style, its position is easily adjusted to place the grinding wheel as required in relation to the arm (15). This arm must then be clamped securely to its support.

At (16) a section of the cutter is shewn in position for grinding its cutting edge, the flat face of the cutter being inclined a little from the horizontal. By partially rotating the cutter (say 200°) in the *direction of the arrow*, it may be ground to the required shape shown in Fig. 32 with its cutting edge more prominent than the rest of the half cylinder.

The best method is to withdraw the socket from the face (19) of the arm, turn the flat face of the cutter to the position (16) *not quite horizontal*, slide the socket gently forward until its shoulder (18) stops against the arm, and promptly, but slowly, turn it half-way round in the direction of the arrow.

The left thumb should be pressed firmly upon the grinder socket at (14), while it is turned with the right thumb and finger holding it lightly at (17), as shown in Fig. 34.

Skill must be exercised to avoid any softening of the

cutter, which will occur unless the grinding wheel be given sufficient time to do its work easily; and the operation cannot be deemed complete until the play of sparks has become equal at all points of rotation of the cutter and has almost or entirely ceased.

By using the feeding device to adjust the height of the grinding wheel, its tapering edge may be brought into sufficient contact with the cutter to grind a little at a time only, and the wheel must be raised from time to time as the work proceeds until the cutter is of the required shape and size.

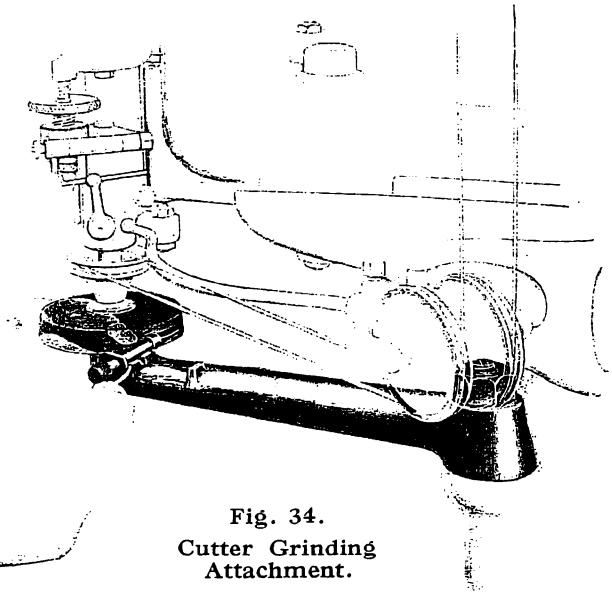


Fig. 34.
Cutter Grinding Attachment.

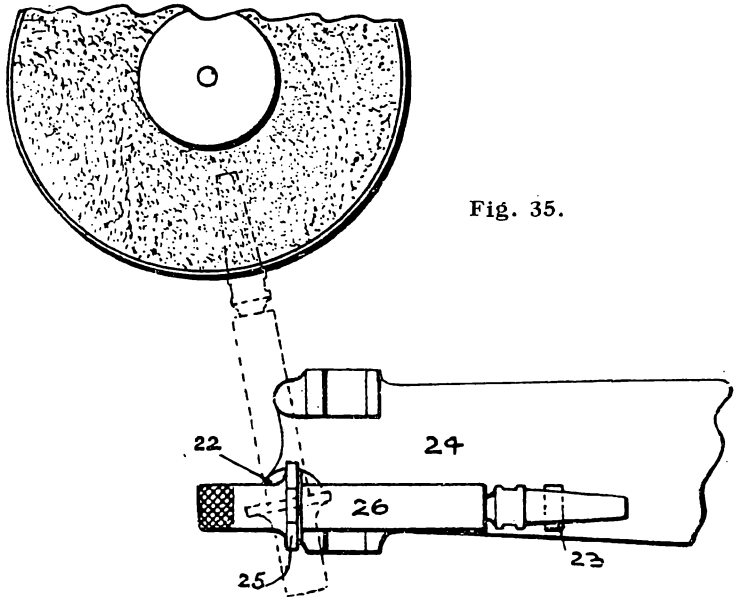


Fig. 35.

The flat face of the RIGIFLAT cutter should be ground on the upper face of the grinding wheel, as shown in Fig. 35.

For this purpose, in putting the cutter to be ground into the socket, one of the socket flats (25) is rested on the arm face (22) while the flat face of the cutter is bedded on the arm face (23).

The cutter so fixed in the socket may then be applied to the grinding wheel as shown by the dotted lines, and swept over its upper surface, the flat of the socket being kept bedded on the face (22) of the arm. Suitable adjustment of the height of the grinding wheel must be made by means of the feeding device.

A triangular recess is formed in the rim of the work-pan to hold the flange of the socket when extracting a cutter by means of the wrench.

CONICAL CUTTERS

The conical pointed RIGIFLAT cutters, shown in Fig. 36, which are used for engraving fine lines without burr, are generally best ground to 90 degrees (45 degrees to the axis). They are sharpened as already described, but require much greater care than the cylindrical cutters. The flat must be carefully finished on the oilstone and must be exactly on the cutter axis *at the point.*

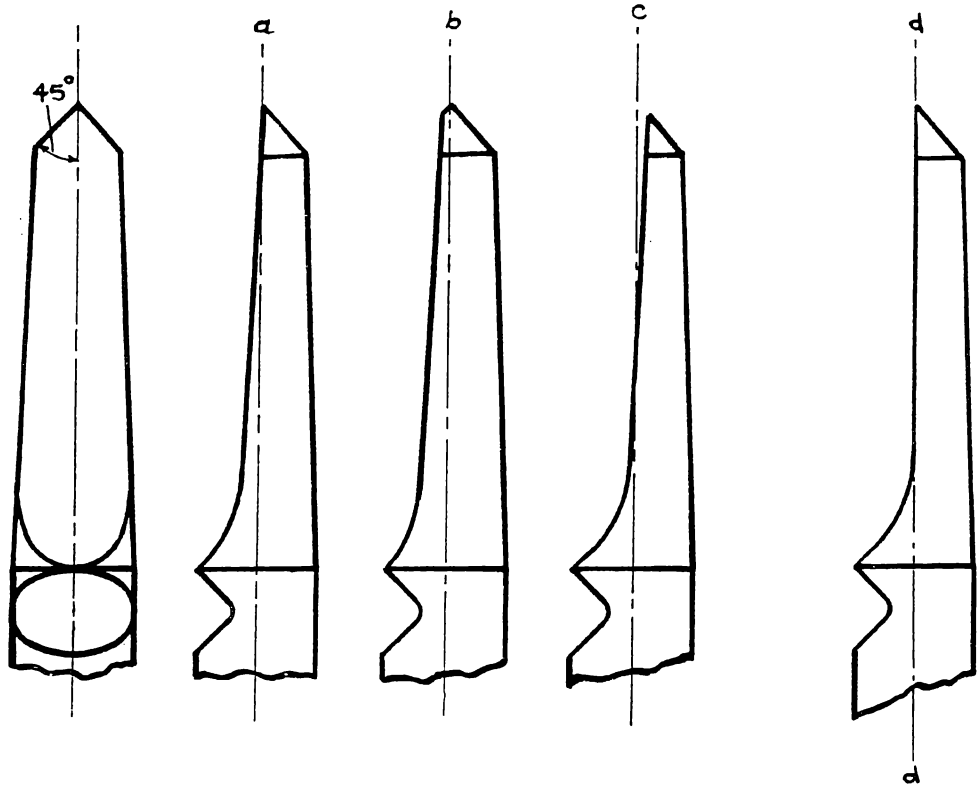


Fig. 36.
Showing Rigiflat Cutter.

Fig. 36A.
Showing Axiflat Cutter.

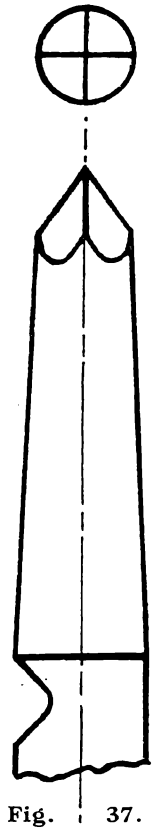


Fig. 37.

Fig. 36 shows at (*a*) the point of a conical RIGIFLAT cutter correctly ground, *i.e.*, the flat is exactly on the cutter axis at the end. At (*b*) is shewn the fault of having the flat prominent. At (*c*) is shewn the fault of having the flat undercut. Fig. 36A shows an AXIFLAT cutter with the entire length of its flat ground along the axis d.d. AXIFLAT cutters are supplied in certain sizes only (See Cutter pamphlet).

The cutting edge, as the cutter revolves, must have everywhere more prominence than the rest of the cone. This may be checked by slowly rotating the cutter in the cutter spindle over a piece of white paper and examining the cutter edge by the aid of the magnifier.

It is not desirable to work with the point of the cutter perfectly sharp, and it should be truncated to produce a small flat with clearances in two directions as indicated in Fig. 31. If this flat is no more than one or two thousandths of an inch wide, it is best produced with the oilstone provided. If it is a large truncation for broad lettering of shallow depth, the end of the cutter can be ground off on the grinding wheel.

PYRAMID CUTTERS

The Pyramid cutter, Fig. 37, scrapes rather than cuts and though its life is short it is peculiarly suitable for some classes of work such as engraving the tool steel dies used to coin typewriter type. Small errors in the grinding of cutters of this type are very serious and for satisfactory results they should be ground in the machine spindle. Special means are provided for doing this when required.

CUTTER SPEEDS

MATERIAL	TYPE OF CUTTER	Width of Cut	Clearance Angle	R.P.M. OF CUTTER	LUBRICANT
Free Cutting Brass. Sheet Zinc ...	Talycut	up to .10-in.	32°	15000	None
Tough "cartridge" brass	Talycut	,, .01-in.	24°	8780	Frapol No. 77
	Talycut	,, .10-in.	20°	5000	Frapol No. 77
Aluminium	Talycut	,, .01-in.	32°	15000	Paraffin
	Talycut	,, .10-in.	24°	8780	Paraffin
Bakelite ...	Talyspeed	,, .10-in.	32°	15000	None
Mild Steel ...	Talyspeed	,, .01-in.	24°	8780	Frapol No. 77
	Talyspeed	,, .10-in.	20°	5120	Frapol No. 77
Copper ...	Talycut	,, .01-in.	32°	8780	Paraffin
		,, .10-in.	24°	5120	Paraffin
Staybrite Steel ...	Speedicut	,, .05-in.	24°	5120	Frapol No. 77
	Speedicut	,, .10-in.	20°	3000	Frapol No. 77
Tool and Die Steel	Talyspeed	,, .05-in.	20°	5120	Frapol No. 77
	Talyspeed	,, .10-in.	20°	3000	Frapol No. 77

Turpentine is an excellent lubricant for fine work on tool steels, also for use on glass with a diamond cutter. Frapol No. 77, diluted with turpentine (3 to 2) is a suitable lubricant for use on copper, silver and phosphor bronze.

The above is reprinted from our special booklet (referred to on page 37) "Cutter Grinding for Taylor-Hobson Engraving Machines." The clearance angles are definitely controlled with our later type grinders but when grinding in the cutter spindle on "C" and "CB" models, the clearance angles will have to be estimated. Our special pamphlet on cutters gives further recommended uses.

CUTTER GRINDER (MODEL "D")

This is self-contained for fixing on a bench and will grind the cutters in a variety of shapes. The functioning part of this grinder without the base and motor, attaches to our "CX" and "CXL" models.

The production of any of the cutter shapes shown in Fig. 39 is accomplished easily with this grinder.

The operation of this grinder is dealt with in the separate instruction book supplied.

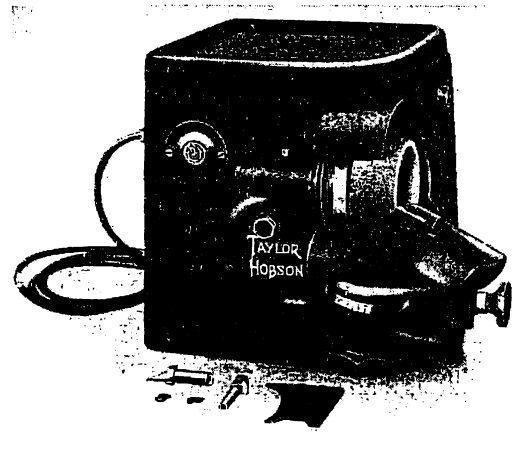


Fig. 38.—Cutter Grinder, Model "D."

Care of Grinding Wheels

Grinding wheels must be kept free from grease, and must not be handled with greasy fingers, or the surface will become choked and glazed, and cutters will be softened.

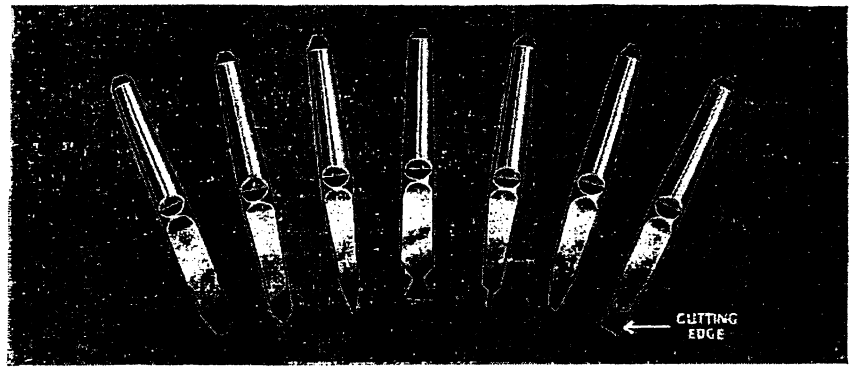


Fig. 39.—Cutter Shapes.

KNIFE DIVIDING ATTACHMENT FOR MARKING FINE GRADUATIONS

The Knife-dividing Attachment is for ruling such fine lines as cannot be well made with a revolving cutter.

It should be bolted to the engraving machine in place of the head, which, together with the pantograph, must be removed. The cutter frame is swung out of the way.

The attachment is provided with adjustable changeable stops to vary the lengths of line ; and the tool, a sample of which is provided with the attachment, should be pressed into the work and drawn along to cut the line or graduation.

For circular dividing, the work should be mounted on the dividing head (see page 34).

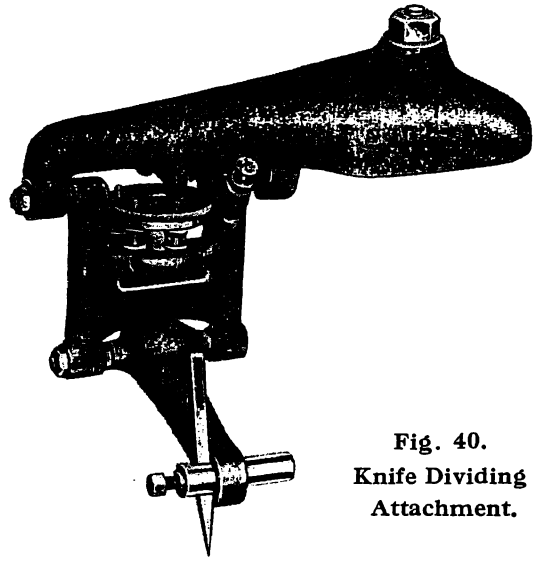


Fig. 40.
Knife Dividing Attachment.

THE ENGRAVING MACHINE IN THE TOOL ROOM

Tool room foremen, especially those engaged on precision work, will find the Engraving Machine capable of many operations for which no other machine tool exists.

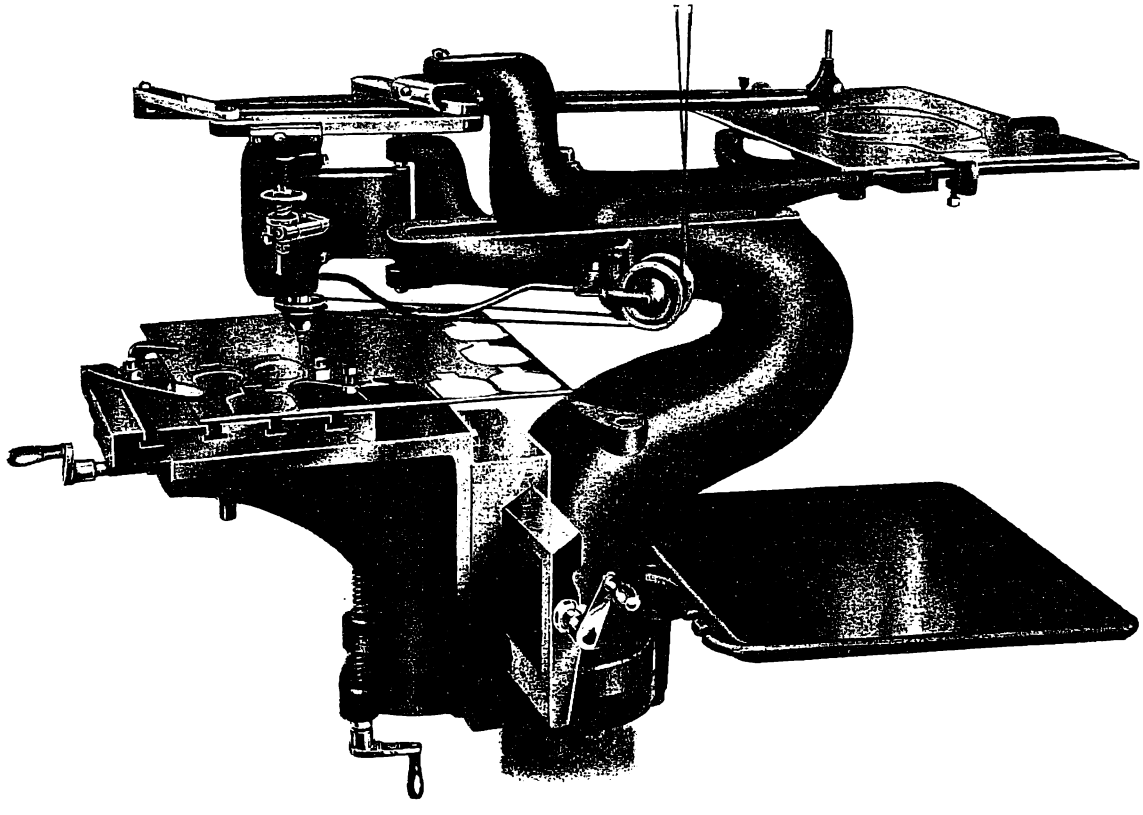


Fig. 41.—The "CB" Machine set up for cutting out Sheet Metal blanks.

Sheet Metal Work

Where a number of uniform pieces have to be made from sheet metal, but the cost of press tools is not justified for the quantity, a large copy of the outline may be made quickly in celluloid (as described on page 27), and the pieces "engraved" out of the sheet accurately and cheaply. (An example of this work is shown in Fig. 41 above).

Engraving, Drilling, Slotting and Milling at one setting

It sometimes happens that a number of small scale plates or similar parts, somewhat as shown in Fig. 42, are required in thin metal, celluloid or the like, and that the quantity is too large for them to be made by hand but does not warrant the making of press tools.

Such parts may be made accurately and economically on the Engraving Machine with home-made set copy.

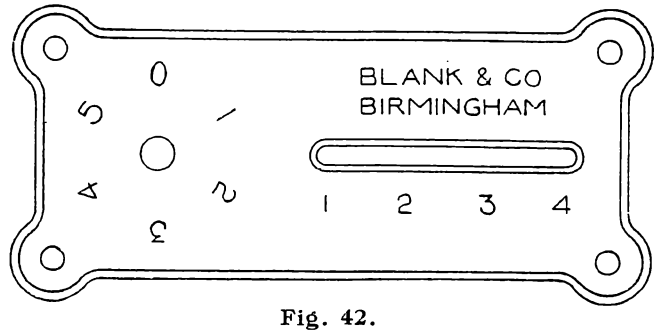


Fig. 42.

In the example shown, the inscription and scales would be engraved, the holes drilled or centred, the slot cut and the plate milled out of the strip with any degree of bevelling or curvature of edge desired, all at one setting.

Two or more tongues of metal would be left to connect the plate with the strip during the cutting out operation. Fig. 43 shows another example of this class of work.

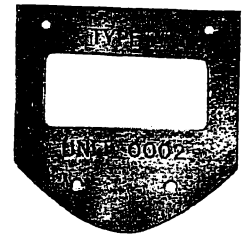


Fig. 43.

Slotting amd Milling

Small slots, either straight or in curves or circular arcs, can easily be cut on the engraving machine. The copy for a circular arc may be a mere link, pivoted about a point fixed on a copyholder, the radius of the link being varied by placing the style in any of a series of holes in the link, or by means of an adjustable slider.

Spiral Slots

Fig. 44 shows a spiral slot machined in the engraving machine as a manufacturing operation. The slot contains half of a steel ball, the other half of which lies in a radial slot in a fixed plate on which the other revolves, this combination of slots and ball forming a stop motion to limit the number of turns of the movable part to some prescribed value.

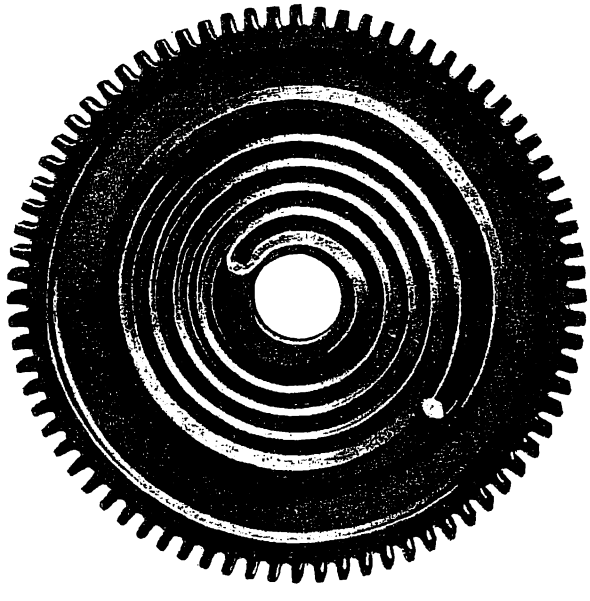


Fig 44.

Involute and Cycloidal Curves

These may be cut on the engraving machine by arranging on the copyholder appropriate wrapping or rolling connections which guide the pantograph style in the prescribed path. The machine is used for this purpose in making master cutters for gear teeth.

Locating Holes

Where a number of holes have to be accurately located in small pieces—whether of sheet metal or otherwise—and the cost of a drilling jig is not justified by the quantity, and also where more accurate work is needed than that generally obtained from a drilling jig, an enlarged copy, consisting of a plate of metal with the holes laid out and centre punched, can be put on the copyholder, and the cutter, in the form of a drill, used to drill the holes, which may be finished in a drilling machine if necessary.

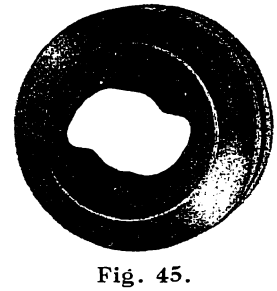


Fig. 45.

Cutting Cams

Small cams of irregular forms which cannot be generated on any ordinary machine tool, can be cut on the engraving machine from enlarged copy. Fig. 45 shows double internal cams produced in this way.

Flat spiral springs (Fig. 46)

These form very convenient means of guiding and effecting small displacements, and can be readily produced on the engraving machine. A suitable spiral is drawn out, say, ten times full size, and using this as a guide, a celluloid copy is made as described on page 27. By this means it is as easy to work to the best theoretical outlines as to any other, and, of course, the method is not restricted to the cutting out of springs.

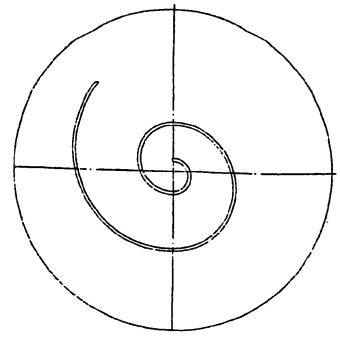


Fig. 46.

Knurls

The engraving machine has been used successfully to produce knurling in sunk panels, for finger grips and the like, using a 90° cutter with a criss-cross copy, the depth of cut being such that the sides of the cuts blend together to give a sharp diamond knurl effect.

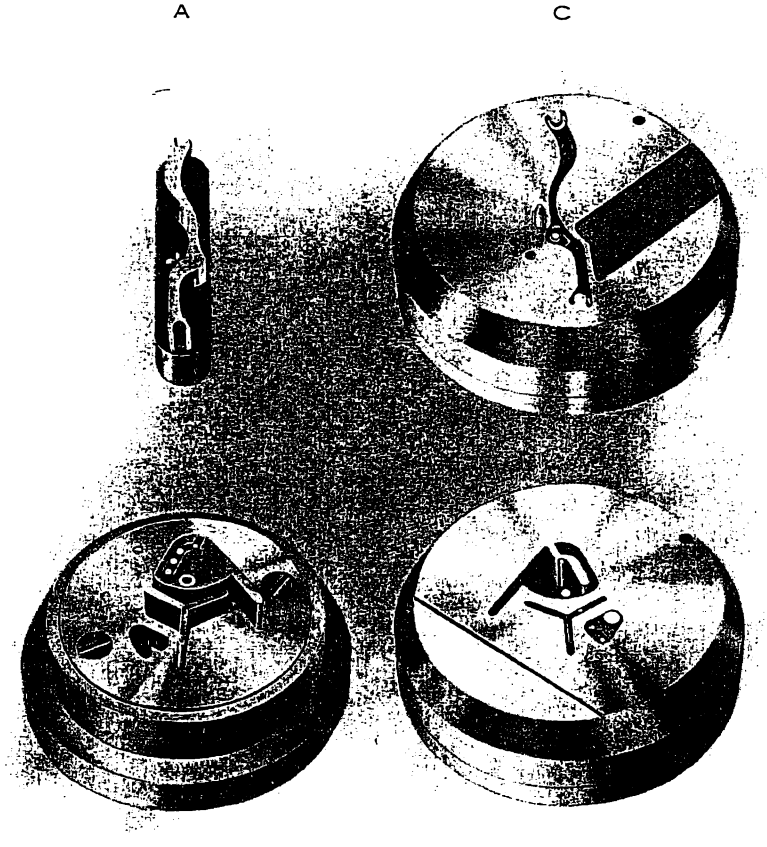


Fig. 47. (Half Size).

Press Tools

Punches and dies may have, their cutting edges accurately outlined from suitable enlarged models in celluloid or metal. Examples of this are shown in Fig. 47. The punches A and B were profiled from relief copy. The dies C and D were cut from sunk copy.

Punches for thin sheet metal

It is difficult to secure clean blanks when punching very thin metal with ordinary press tools, because, when the thickness of the metal is of the same order as the clearance between the punch and die, the edges of the blank are drawn over and tear raggedly, instead of shearing cleanly.

Instead of a die of the conventional type, a plain pad of rubber may be employed. The punch "immerses" the sheet metal in the rubber, which flows closely around the sharp edges of the punch, and tears the blank out cleanly. To get the best results, the punch may be made by engraving the outline of the blank on a suitable block of steel. The working depth of the punch is not very great; it is sufficient to cut the groove about $\frac{1}{32}$ inch to $\frac{1}{16}$ inch deep. Its cross section should be as indicated in Fig. 48, the blank being defined by the square edge.

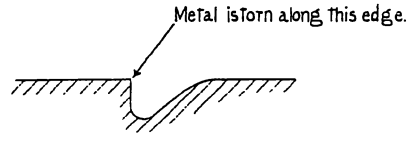


Fig. 48.

Coining and Marking Dies

Sometimes it is more convenient to cut in reverse a die or a hob, with which to coin an inscription or design, than to engrave directly. The engraving machine is extensively used for cutting marking dies, stamps, etc., as well as dies for coining medals, tokens, etc., in soft metals or even carbon steel. Typewriter manufacturers, for example, use our machines for cutting the dies with which the typewriter type is coined and we supply a special machine (see page 46) for cutting these dies on a radius to suit the typewriter platen.

Grinding Form Cutters

The engraving machine can be used also for the accurate grinding of small form cutters, working from an enlarged template, say 10 times the scale of the profile to be ground. Fig. 49 shows the machine, diagrammatically in plan, set up for work of this class.

The grinding wheel is carried on a spindle independently mounted on the table of the machine while the cutter to be ground is carried on an auxiliary table free to roll on balls contained in rectangular V-grooves under the control of the pantograph. The arrangement of ways permits this auxiliary table to move freely, and without rotation, in all directions ; a special plug, which takes the place of the cutter spindle quill and engages with a socket in the auxiliary table, causing it to follow the motion of the pantograph. As the table is constrained against rotation, every point on it will execute the same motion, corresponding to the path followed by the style.

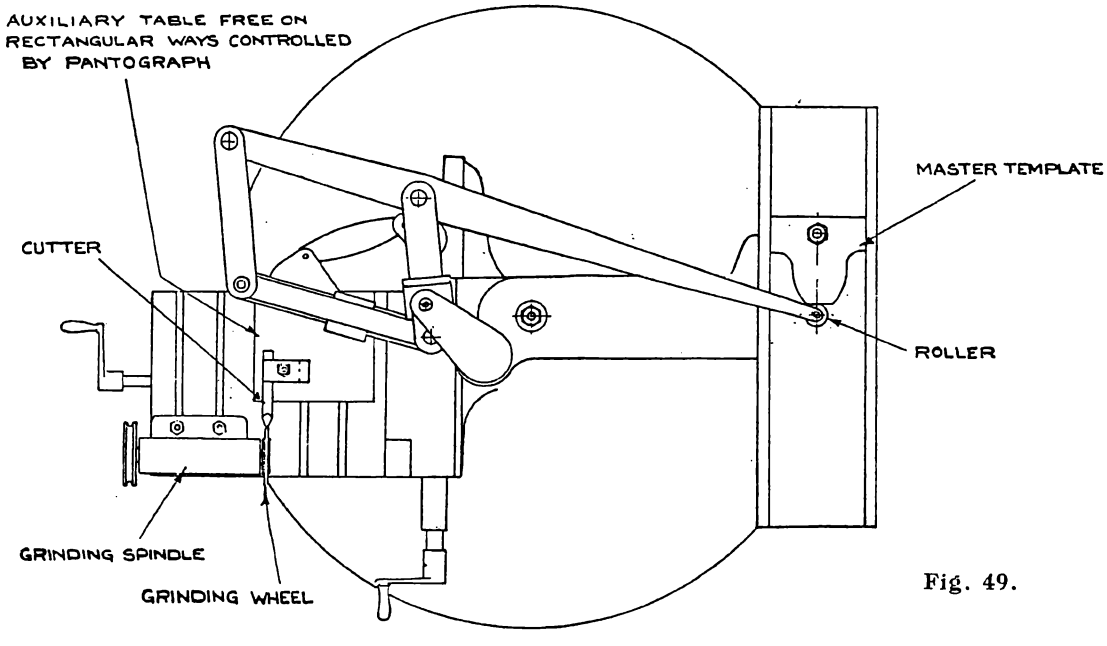


Fig. 49.

Thus, by truing the section of the periphery of the grinding wheel to a radius proportionate to that of the style roller, the movement of the wheel with respect to the job will reproduce that of the roller around the template, and the cutter will be accurately ground to the desired profile.

Moulds

The engraving machine is invaluable for cutting lettering in moulds for every kind of plastic material, and can often be of great assistance in cutting fancy designs in them.

SPECIAL MACHINES AND ATTACHMENTS FOR ENGRAVING ON CURVED SURFACES

TYPE DIE MACHINE

The special Type Die Engraving Machine, with micrometer feed (Fig. 50), is used for cutting dies for typewriter type with curved faces to suit the platen. This machine may also be used for engraving on cylinders as shown in the illustration. The vertical motion of the cutter spindle is controlled over the cylindrical surface by means of a crank (C). This crank is adjustable to operate at varying radii between 15 and 22 mm. The vertical screw beneath the table brings the work up to the cutter, as on the normal machine, but to obtain fine feeds, the screw is locked with lever "L" and the large graduated feed wheel is brought into play. This raises and lowers the table on the fixed vertical screw and for convenience is graduated in units of .001 inch.

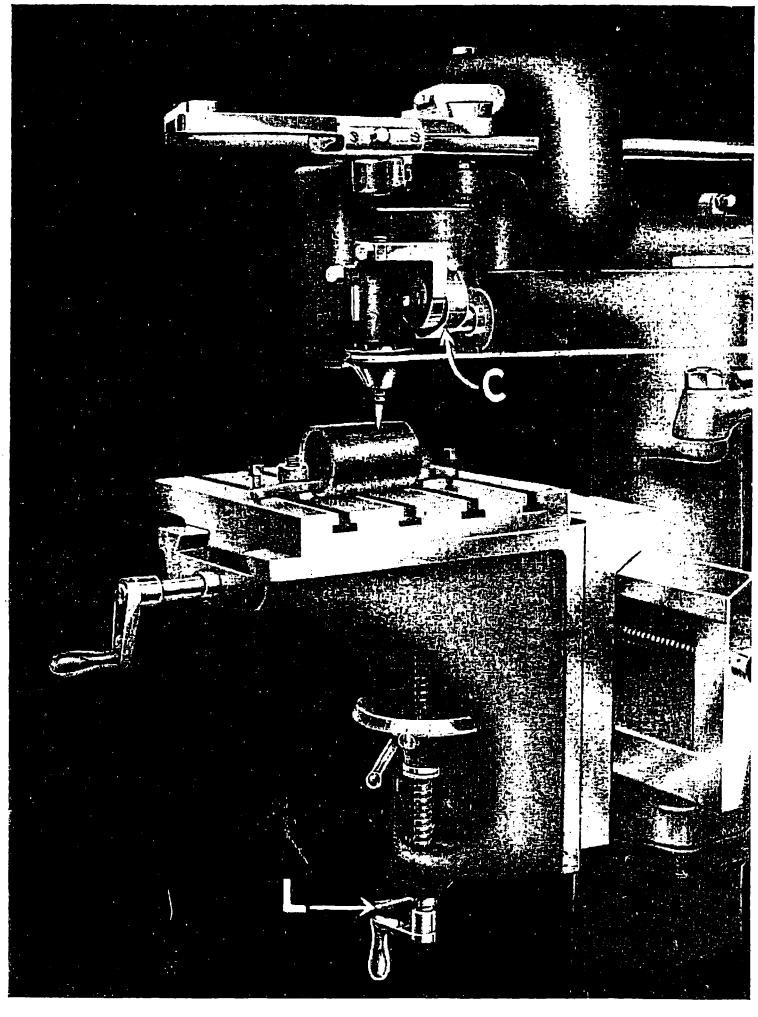


Fig. 50.—Type Die Machine

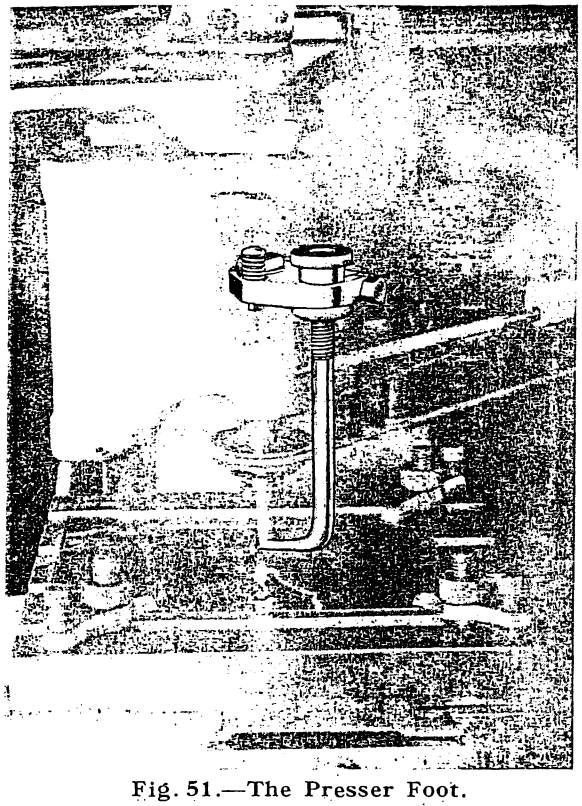


Fig. 51.—The Presser Foot.

head and carries a master former (B) which should preferably be in hardened steel, forming a counterpart of the work surface. The feed mechanism is removed, as described on page 14 and the attachment (C) is fixed to the cutter spindle in place of the usual feed and yoke. A spring in this attachment keeps the style in part (C) in contact with the former so that as the cutter is traversed, it follows the contour of the work. To keep the style rigidly upright the steady (S) is attached to tapped holes in the long graduated pantograph bar. In setting this steady, it must be adjusted so that the spring can move the style and the spindle freely without bias.

The depth of the cut is adjusted by means of the vertical slide screw beneath the worktable. To withdraw the cutter for each character when the depth has been set, the feed screw (F) is slacked back. It is important to work always with this screw (F) up against its shoulder and the thickness of the former (B) must be such as to allow of this.

The surface of the former needs lubricating.

THE PRESSER FOOT

The presser foot attaches to the machine spindle in place of the ordinary yoke as illustrated, the foot itself being cloven and fitting close up to the cutter. It limits the depth to which the cutter will penetrate and is useful for operation on undulating surfaces. It is quicker in use than the differential feed described on page 16, and is particularly suitable for engraving uniform graduations on lengthy scales which may not be flat. It is apt to scratch the work surface and cannot be used where there is not a finishing operation afterwards.

The presser foot is assembled as shown in Fig. 51 and the spindle is held down to the work surface by light hand pressure on the yoke.

THE FORMING ATTACHMENT
(For Models "C" and "CB")

This engraves on curved surfaces. The attachment illustrated in Fig. 52 necessitates a special machine head in place of the standard one. (This special head can be fitted when new or at any time afterwards and does not interfere with the normal use of the machine). An arm (A) bolts to this

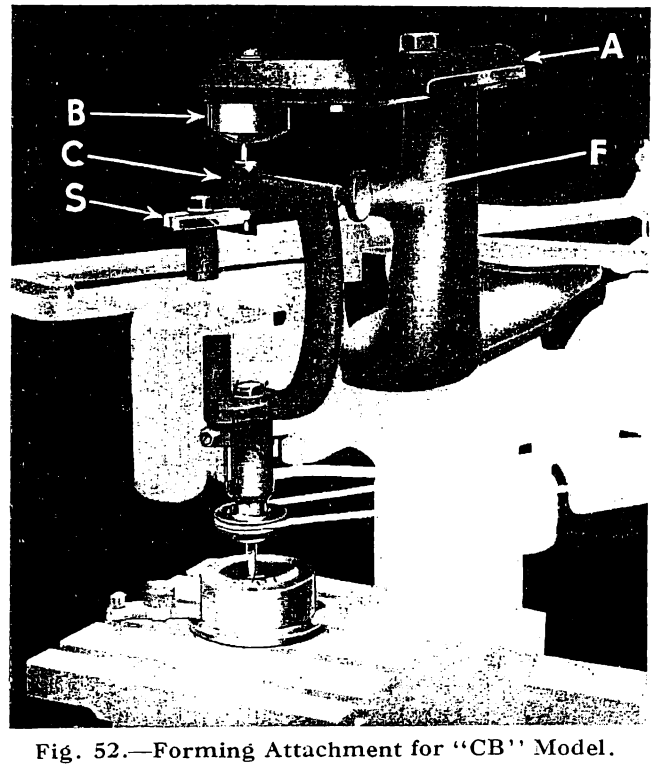


Fig. 52.—Forming Attachment for "CB" Model.

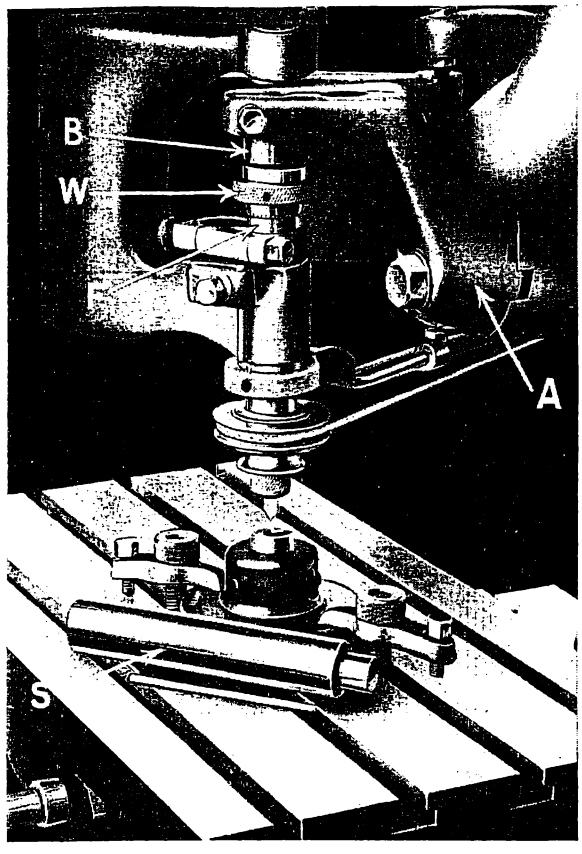


Fig. 53.—Forming Attachment for "CX" Model.

THE FORMING ATTACHMENT
(For Models "CX" and "CXL")

This comprises a bracket (A) Fig. 53, which bolts to the machine frame. This bracket carries the former (B), which should preferably be of hardened steel and should have a $\frac{1}{2}$ inch diameter shank machined on it to fit the bracket. The contour on the former face (which is a counterpart of the work surface) must be machined central with the shank. This facilitates setting up which can then proceed as follows :—

Remove cutter spindle, yoke and feed mechanism as described on page 14.

Set pantograph at reduction required.

Fix copy loosely on copyholder and set style on a true centre spot on the copy.

Fit setting bar (S) in cutter spindle frame and adjust head (H) on machine frame until $\frac{1}{2}$ inch spigot on bar (S) will enter $\frac{1}{2}$ inch hole in bracket (A).

Tighten head (H) and clamp copy firmly, keeping style in centre spot.

Remove bar (S) and fit former (B).

Remove grease cap from back end of cutter spindle and assemble feed screw (F). Replace spindle in cutter frame and assemble yoke, spring, and spring box, as illustrated. Tighten yoke to prevent spindle revolving and lock feed screw (F) tightly on to spindle with tommy bar passing through hole in feed wheel (W) into hole in screw (F). The angular position of the spindle should be adjusted so that the zero line on screw (F) is facing the operator. The spring keeps the spindle pushed up against the former which requires lubricating.

Finally the work is centred accurately beneath the spindle and former using a truly ground pointed cutter in the spindle as a means of indication.

The graduations on feed wheel (W) are in units of .001 inch.

THE ROLLING ATTACHMENT

A difficult problem solved very successfully on the engraving machine is the engraving of rollers : for example such as are used for printing. It is usual to engrave a continuous design over the surface of such rollers. Fig. 54 shows the rolling attachment designed for holding cylindrical objects in such a way that while the cutter is moved about under the action of the pantograph, the object is rotated automatically beneath it, so that engraving on a cylinder may be done with the same facility as engraving on a flat plate.

The roller is chucked on a spindle turning in a carriage, which is free to move along ways square to the axis of the spindle.

Keyed to the spindle is a master drum, the diameter of which corresponds to that of the roller to be engraved. A control wire is wrapped round this drum with its ends clamped to the base of the fixture, and revolves the roller in step with the carriage, as this is moved along its ways.

Movement of the cutter along the axis of the roller does not move the carriage, but movement square to the axis moves with it the carriage and roller ; the wires round the master drum revolving the latter so that the surface of this is, as it were, unrolled under the cutter. The cutter is always radial to the roller which is engraved on just as though its surface were split down and spread out flat.

When the engraving is a few thousandths deep only and consists of fancy designs and lettering, it has been found quite practicable to work from copy which consists simply of the pencilled design on cardboard. A good grade of cardboard is required with a smooth face free from any directional graining. The style arm is sprung *lightly* so that the style steadies itself in the cardboard. This method is not, of course, suitable for precision engraving.

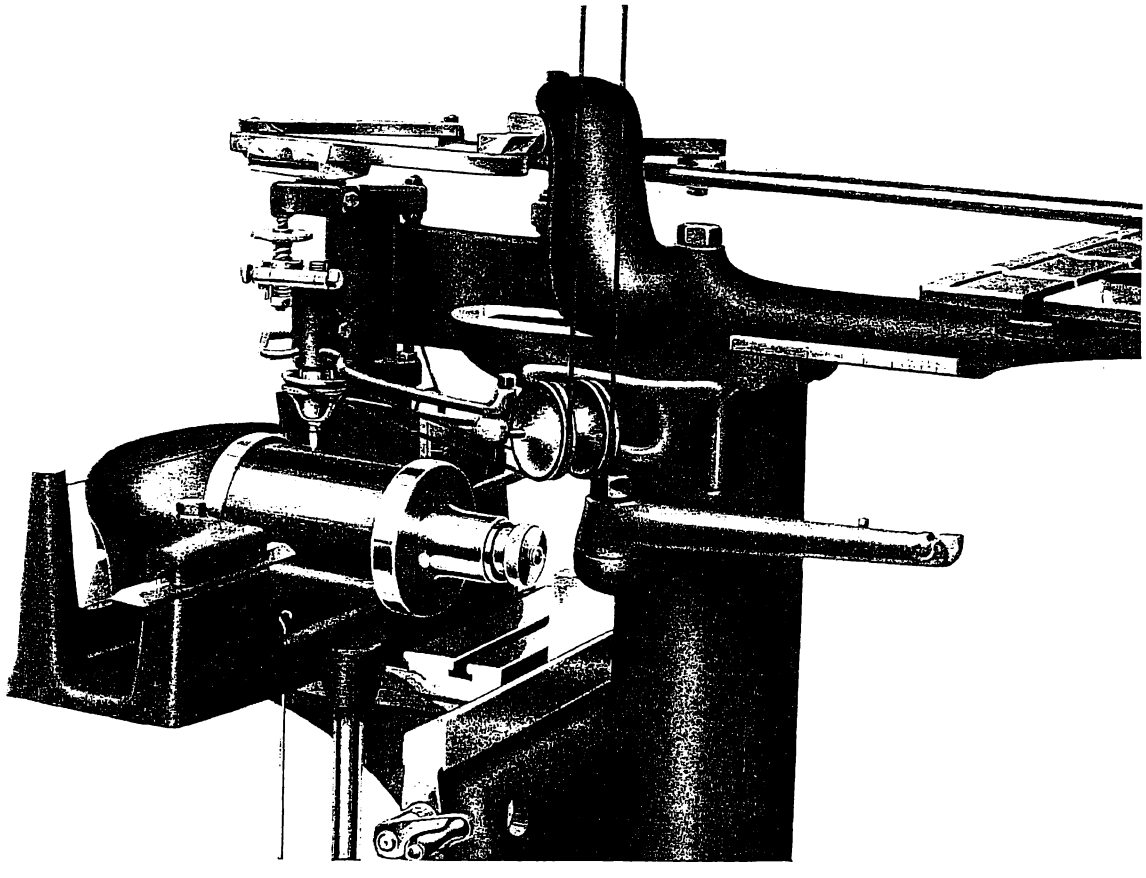


Fig. 54.—The Rolling Attachment.

ENGRAVING ON NON-METALLIC MATERIALS

VULCANITE, BAKELITE, ETC.

These and like materials can be engraved easily with the same speed and procedure as for metal. No lubricant is required. (See table on page 40).

WOOD

Cutters for wood should have their cutting edge angles made acute, and this can be done by grinding the flats past the cutter axis. A high speed is desirable for wood.

MARBLE

Marble can be engraved satisfactorily, using Speedicut steel cutters well-lubricated with water and running at about 5,000 r.p.m. for $\frac{1}{4}$ inch letters. Cutter needs ample clearance—about 30°.

GLASS

Diamond or Wimet cutters are available for this purpose and are sometimes useful for other work on account of their resistance to wear. But they are liable to fracture on hard and tough materials, such as steel. (See table on page 40).

FILLERS AND FILLING

Engraving to be wax-filled is preferably executed with a parallel-sided cutter. From such cuts the filler is least liable to be detachable by rough usage. But if the material is such that a parallel-sided cut cannot be made without objectionable burr, it may be necessary to use a conical or truncated conical cutter. For security of the filler, the angle should not, however, exceed 60 degrees.

To obtain the best results when filling engraving, a substance is required which does not shrink as it sets, otherwise it will not remain flush with the surface and may fall out. It should also wear well and stand exposure without discolouration. The Taylor-Hobson Fillers possess all these qualities to a marked degree. They are of three kinds :—

1 Kwikfyl

A wax filler for light engraving in metal, vulcanite, bakelite, ivorine, etc. We stock Kwikfyl in black, white, red, blue, green, yellow, silver and gold, other colours made specially if ordered in bulk.

Kwikfyl is applied as follows :—If any lubricant has been used in engraving, it must be thoroughly removed with a suitable wash. The filler is applied warm and if the article to be filled is of metal, or a good heat conductor, it is necessary that it also should be warmed. This warming is best done on a metal lid placed over a shallow tray containing boiling water heated on a gas ring. If a large amount of filler is to be used, it may be heated, preferably in a water-jacketed vessel such as a glue or porridge pot (it becomes plastic at about the temperature of boiling water), and may then be worked into the engraving with a smooth spatula.

For small jobs Kwikfyl should be worked into the engraving with a heavy spatula heated in a smokeless flame (a smoky flame will discolour the filler). This is probably the best method for most work. After being allowed to become quite cold, the engraving should be rubbed down flush with a

single thickness of lint-free cloth, such as twill sheeting, stretched tightly over a flat cork or wooden block, and lightly moistened with paraffin. The paraffin sold as "turpentine substitute" is more effective than that sold for burning. Finally the job is cleaned with a swab moistened with clean water.

Kwikfyl can be applied cold if it is previously melted and sufficient boiled linseed oil is stirred in to leave it just plastic when cold. This is sometimes handy for very light work such as press-formed graduations in celluloid, etc., but there is a risk of the filler falling out. It should never be used in this form for other than very fine cuts.

2 Durafilla

A hard wax filler suitable for door plates and memorial brasses. We stock black and red and can supply a large variety of colours at short notice. Durafilla is only suitable for use on metal, the temperature required being considerably higher than for Kwikfyl. Some filler should be powdered and placed on the part to be filled, which should then be heated up to the melting temperature of the filler, which, as it settles into the engraving, will eject the air and ensure a firm, solid filling. The work should be filled overflush and then finished by rubbing down with speed grit or pumice, and finally polished.

3 Silvalyne

A white metallic filler for engraved scales and the like on metal surfaces where it is essential that the graduations shall remain permanently visible.

Silvalyne is readily applied to brass, bronze and copper, with difficulty to iron, and is not usable on aluminium. The engraving, which must be scrupulously clean and free from grease, is warmed to about the temperature of boiling water. Powdered Silvalyne is then brushed into the lines with a camel hair brush, 5% hydrochloric acid being used as a flux.

Silvalyne amalgamates with the metal to which it is applied, and expands as it cools, giving a raised effect. If it is applied before the part is finished it may spread beyond the engraving to the adjacent unprotected furface. In this case it is necessary to finish by rubbing down with emery paper. A good effect is secured by blue ammonia bronzing (cold) before finally lacquering. Some calculating machines are scaled and finished very effectively in this way.

If the work is stove enamelled, Silvalyne may be applied after the finishing. In this case the engraving should be as fine as possible, providing it cuts through the enamel into the metal.

In addition to its serviceability, this silver-like metallic filler has a very attractive appearance particularly on instrument work with a brass or dark enamel finish.

Air-drying Enamel Paint

This can be used as a cheap and easily applied filling. It is brushed over the work and the surplus wiped off with a cloth free from lint. This will give a fairly satisfactory finish, but it is not to be compared with a flush filling.

AMMONIA BRONZING

A very simple and attractive way of obtaining a contrasting colouring in the lettering of engraved brass plates is to dip the whole plate in a black bronzing solution immediately after engraving, then to grain up the plate lengthwise with smooth emery cloth on a file to a high finish. The surface is then sprayed with a protective coat of transparent lacquer.

The equipment is inexpensive and details of the process and the equipment can be obtained from specialists such as *Messrs. W. Canning & Co., Ltd.*, 133/137, *Great Hampton Street, Birmingham.*

ELECTRIC ETCHING

THE TAYLOR-HOBSON RESISTANCE ETCHER

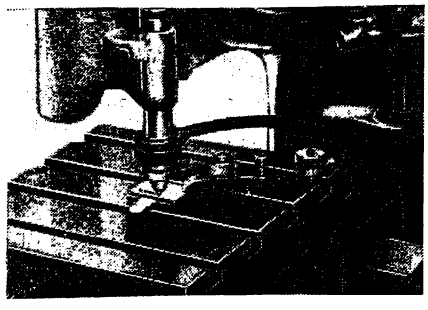


Fig. 55.

This is shown in Figs 55 and 56. It must be connected only to the alternating electric supply for which it is adjusted. Underneath the transformer is a removable plate which exposes terminals for adjusting to other voltages.

The object to be etched must be of metal, electrically connected to the transformer, the writing point being connected to the other transformer terminal. When the writing point touches the object to be etched, the circuit is completed, and the heavy current heats and softens the object locally at the point of contact.

Though the current is heavy the voltage is less than that of any electric bell, being transformed down, so that there is no risk of shock and the power consumed is negligible.

A four-way switch is provided for varying the strength of the writing current.

The writing point, which is easily replaced, is made from a special heat resistant material which far outlasts the usual copper point.

The holder in which this is held is of special ventilated and insulated construction. It does not become uncomfortably hot in use and is specially designed so that it can be used either by hand, as shown in Fig. 56, or in an engraving machine, as shown in Fig. 55. When used in the machine the holder takes the place of the usual cutter and spindle, and with standard copies, as illustrated in this book, the utmost neatness and accuracy are secured.

For freehand use the circular table illustrated can be employed. This is supplied as part of the equipment. It is connected to one terminal of the transformer and the object to be marked rested on it.

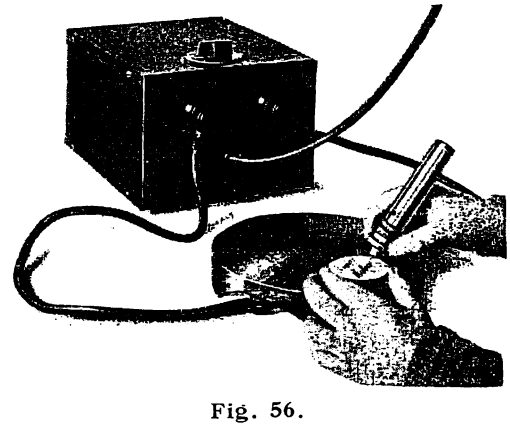


Fig. 56.

If desired we can supply the holder and writing point without the transformer and other accessories. This enables a customer already owning an electrical etching apparatus to enjoy the advantages possessed by our design of writing holder, and the convenience of using it in his Taylor-Hobson Engraving Machine.

Instructions for connecting up and using the Resistance Etcher

Connect two wires of the main cable from the transformer to the electricity mains by means of a lamp holder adaptor or a wall plug. Use the red and black wires. The third wire in this cable is the earth wire. It is coloured grey and clearly labelled. In order to comply with the Board of Trade regulations this should be coupled to the conduit casing, a water pipe or other convenient earth point.

The writing holder can be connected to either of the two terminals in front of the transformer.

The separate flex is provided, to connect the work to the other transformer terminal.

When using the machine this should be connected to the machine table, using the special bolt and nut provided. When used freehand it should be connected to the circular table as shown in Fig. 56.

In some cases it will be more convenient to couple this return flex directly to the work being marked. This should be done when it is desired to obtain the deepest possible marking, but it is usually sufficient to connect to the table on which the work rests, as described above.

Around the switch on the top of the transformer are the words "off," "minimum," "medium" and "maximum." These indicate different degrees of current to suit all conditions.

Before commencing to etch, the transformer is switched on and the marking point brought into contact with the work. Lifting the point away from the work again breaks the current.

When used in the Taylor-Hobson Engraving Machine the holder takes the place of the cutter spindle, as shown in Fig. 55. It should not, however, be clamped in position, but should remain free to be raised and lowered by hand. The copy is traced round in the usual way, the writing point being kept lightly in contact with the work by control of the hand.

Do not use the machine feed, or there is a risk of breaking the marking point. This is rather brittle, and should be handled with care. It should project out of its holder about $\frac{5}{16}$ inch to $\frac{3}{8}$ inch. If used with too short a projection the holder will get unnecessarily warm ; if it projects too far there is a risk of breaking the point.

THE TAYLOR-HOBSON JAVELIN ETCHER

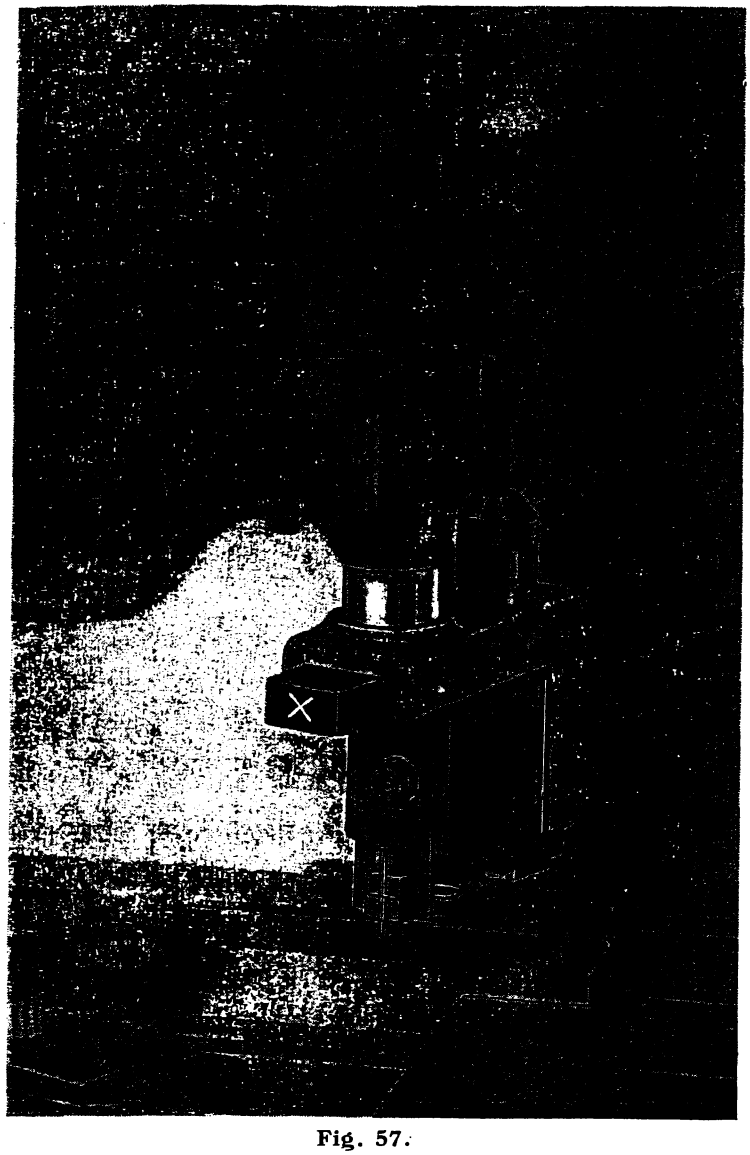


Fig. 57.

The single Javelin Etching unit is illustrated in Fig. 57. It fits any Taylor-Hobson "C", "CB", "CX" or "CXL" model engraving machine, but is not suitable for hand use. Multiple units are made, being built into special machines marking up to 15 parts simultaneously.

The marking is done by a renewable vibrating point. This makes and breaks a low tension circuit through the work, the marking being engraved by the rapid succession of tiny arcs so formed.

The marking point (the "Javelin") is the only wearing element. This is self-feeding and automatically follows up its own wear. Similarly it accommodates itself automatically to variations in the height or curvature of the work to be engraved, and will work equally satisfactorily on flat or curved surfaces. No adjustment is required, and throughout its working life it maintains uniform width of engraving without any sharpening or other attention. When necessary a new javelin is quickly inserted.

The apparatus operates on low voltage supplied from a special transformer unit included with the equipment. This plugs into any lighting circuit and incorporates a rotary switch for varying the strength of the writing current.

Note that this apparatus can only be operated from a 50 cycle A.C. supply, or alternatively we can adjust for a 60 cycle supply.

Instructions for connecting up and using the Javelin Etcher

On the top of the transformer case is a three-pin socket and a terminal box. The marking unit is wired to a three-pin plug which fits into the socket. The return connection for the marking current from the machine table is obtained automatically by means of this socket, the path of the current being through the shank by which the unit fits the machine. It is, however, important to ensure that this is in good electrical connection with the cutter frame, and that the work being marked is not insulated from the table.

With this etcher, unlike the resistance etcher, the shank should be clamped in the cutter frame and not allowed to slide in it. It is unnecessary to employ the feed, as will be explained later.

A length of rubber covered cable is supplied and wired up to the terminal box (marked "*input*"). The loose end of this cable should be connected to the electric supply, using the red and black wires. The grey coloured wire is for "earthing" and is clearly marked so. To comply with Board of Trade regulations it should be attached to a water pipe, the conduit casing or other convenient earth point.

Provided in the top of the transformer case is an "on" and "off" switch, and a rotary switch giving six different strengths of marking current.

There is a further switch built into the marking unit. This is employed when operating the etcher, and its use will be described later. Note, however, that once the transformer has been wired up and switched on it is necessary to depress this final switch to bring the unit into operation.

The marking unit comprises essentially a stiff spring reed at the end of which is mounted a little hammer head, on the front face of which is formed a "V" groove. The javelin fits this groove and is held in position by a little wire clip.

When the transformer is switched on and the lever switch (x) on Fig. 57 is depressed, the reed is set in vibration, and the javelin projected down the slot in which it fits towards the work. The head formed on the end of the javelin ensures its remaining in the slot.

The work is mounted on the table of the machine. It need only be held quite lightly, but must be in electrical contact with the table. It is lifted by raising the table until it comes into contact with the vibrating javelin. The precise height is unimportant as within the range of motion permitted by its length, the javelin automatically adjusts itself to a suitable working position.

When working, a succession of bright sparks will be noticed at the point of the javelin.

The machine is operated in the usual way except that when moving from letter to letter it is not necessary to lower the work. Simply release the pressure on the switch lever (x) already mentioned. The javelin will cease vibrating and will take up a position just clear of the work. When next the switch is depressed it will continue marking as before.

In order to ensure the best results the copy should be followed at a steady rate. Jerky motions, particularly on long or sweeping lines, should be avoided, and such lines should not be traced too rapidly. It is only necessary to go round the engraving once. A second or third repetition will not result in deeper marking.

The depth of marking obtained depends on the strength of current employed. No. 6 tapping on the transformer will give the deepest marking. The lighter the marking, the less the wear on the javelin. This becomes increasingly rapid as the deeper markings are employed.

Javelins are available in different sizes to suit engraving of different widths. The size of javelin however, does not greatly affect the depth obtained, which depends chiefly on the strength of current employed. A special feature of the javelins is that throughout their working life they maintain a uniform width of line.

Javelins are specified by number, according to their diameter. Stock sizes are Nos. 5, 7, 10 and 14 corresponding to diameters of .005 inch, .007 inch, .010 inch and .014 inch. These will be found to cover most requirements. This method of marking is not suitable for wider lines than these will give.

Note that the satisfactory working of the marking unit is largely dependent on accurate adjustment of the vibrating reed and the correct setting of the stop on which this strikes, and these should not be tampered with.

WHAT WE MAKE

ENGRAVING MACHINES for cutting letters, figures and designs in metal, wood, vulcanite and other materials. Used by the principal railroads, shipbuilders, trade engravers, instrument manufacturers, engineers and others.

★

ELECTRIC ETCHING APPARATUS AND MACHINES embodying the JAVELIN PROCESS, for etching trade-marks on metal goods and components to replace acid etching. They are used extensively by manufacturers of aero and motor engines, while most of the Sheffield cutlery manufacturers use Javelin Machines for etching makers' names on stainless steel knives.

★

RESISTANCE ETCHERS for writing on hardened steel. They can be used either in the hand or in any Taylor-Hobson Engraving Machine.

★

MACHINES for Drilling and Slicing glass.

★

COOKE PHOTOGRAPHIC LENSES for hand cameras, studio portraiture, commercial photography and photo-engraving.

COOKE SPEED PANCHRO LENSES used almost exclusively in the Hollywood and British Studios for film photography.

★

TAYLOR-HOBSON CINEMA PROJECTION LENSES used in leading cinemas everywhere for screen projection.

★

TAYLOR-HOBSON PROFILE PROJECTORS used in the Engineering Industry.

★

OPTICAL SYSTEMS for sound recording and sound reproduction.

★

SPECIALLY DESIGNED OPTICAL UNITS for commercial use and for scientific research.

★

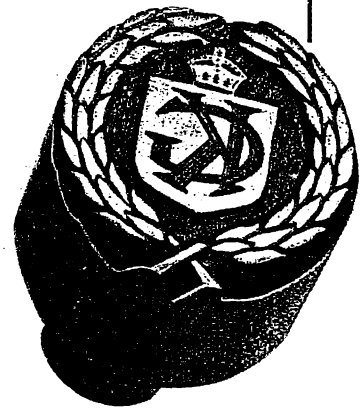
INEXPENSIVE CAMERA LENSES of fine quality made by the unique mass production methods of our Subsidiary Company, the National Optical Company, Ltd.

TAYLOR, TAYLOR & HOBSON LTD

STOUGHTON STREET WORKS, LEICESTER

This is publication No. S.70

Figs. 1



Figs. 1. Showing two brass gold blocking dies, engraved from a copy of the design which was cut out from plastic sheet. Where there are two levels, the plastic copy, upper and lower, are cemented together by a suitable cement.

Fig. 2

Fig. 2. A typical plastic scale which has been engraved from the back with standard copy characters in reverse and filled with colour. This type of work is widely used for indication panels, nameplates and in display work.

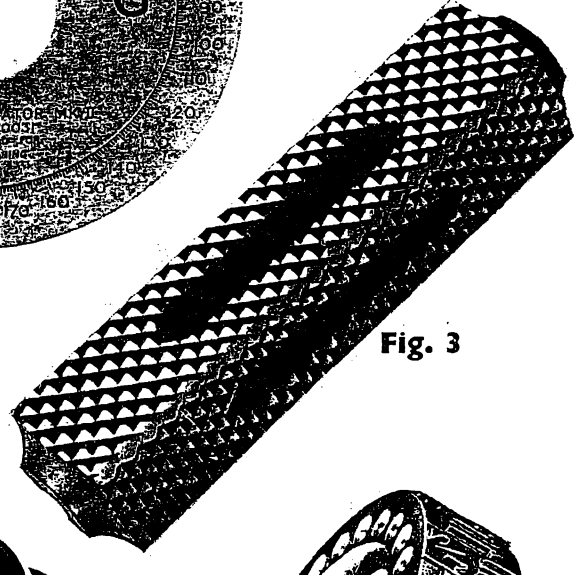


Fig. 3

Fig. 3 is an illustration of a solid steel mould, cut on the engraving machine, the mould being used for white metal cast impressions, from which bicycle pedals are then made in rubber. Rubber soles and heels for footwear are made in this manner.

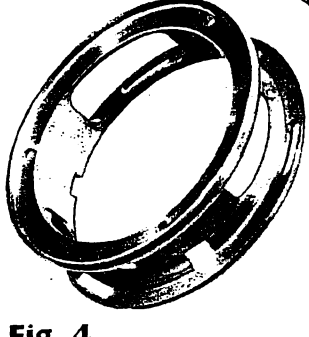


Fig. 4

Fig. 4 is a typical illustration of toolroom usage, and work such as the example is made either by rotating the piece on a suitable revolving table, or by using simple curved line copies.

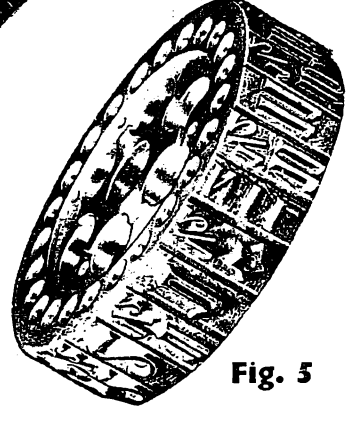


Fig. 5

Fig. 5. Illustration shows a standard printing wheel, which is cut from special raised masters, section by section, by revolving on a suitable table with an indexing device.

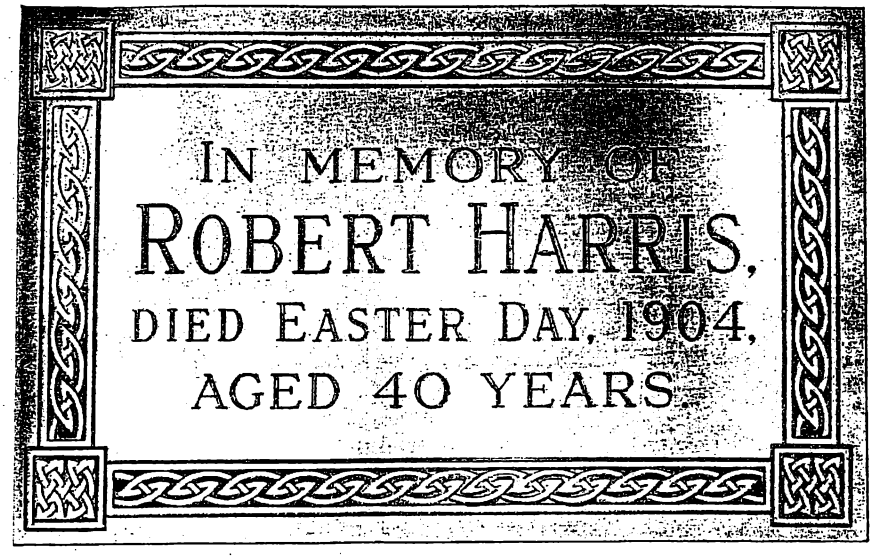


Fig. 6

Fig. 6. A typical memorial plate cut in brass and engraved by using special character sunk copy. This nature of work can be very ornate or quite simple, as on a coffin plate and all manner of name-plates, etc. The border in this illustration is a good example of producing engraving by repeating a small section of the border design, over and over again, around the rectangular plate.

Figs. 7

Figs. 7. All manner of embossed tin lids, milk bottle tops, etc., can be produced from a sunk die, cut on the engraving machine. Two of the tin lids shown have been produced from standard copy, whilst the word 'Ovaltine' was a special drawn copy. No counterpart is used in producing such lids, where they are made out of thin metal, as a suitable rubber sheet will act as the counterpart when work is in the press.

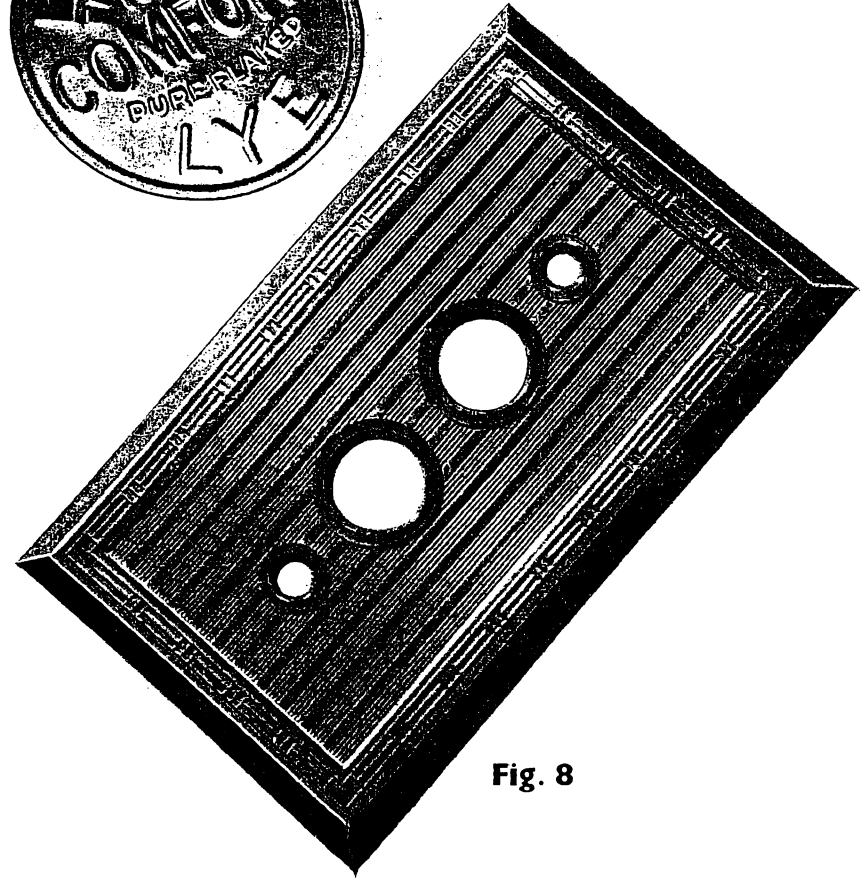


Fig. 8

Fig. 8. The engraving machine is widely used for producing the moulds or dies from which all manner of plastic work is produced as in the example shown of a switch plate. The border in this case required very simple copy, which was repeated by tracing the pantograph style over and over the identical copy.

The examples of engraving shown are by courtesy of:

S. G. Brown Limited, Watford, Herts.

Arrowsmith & Brooks Ltd., London, E.C.1.

Avenue Engraving Co. Ltd., Richmond, Surrey.

A. & G. Edgington, Leicester.

J. S. Drew Ltd., Bath Road, Cippenham, Slough, Bucks.

Parco Industries, Parco Works, Albion Road, Horsham, Sussex.

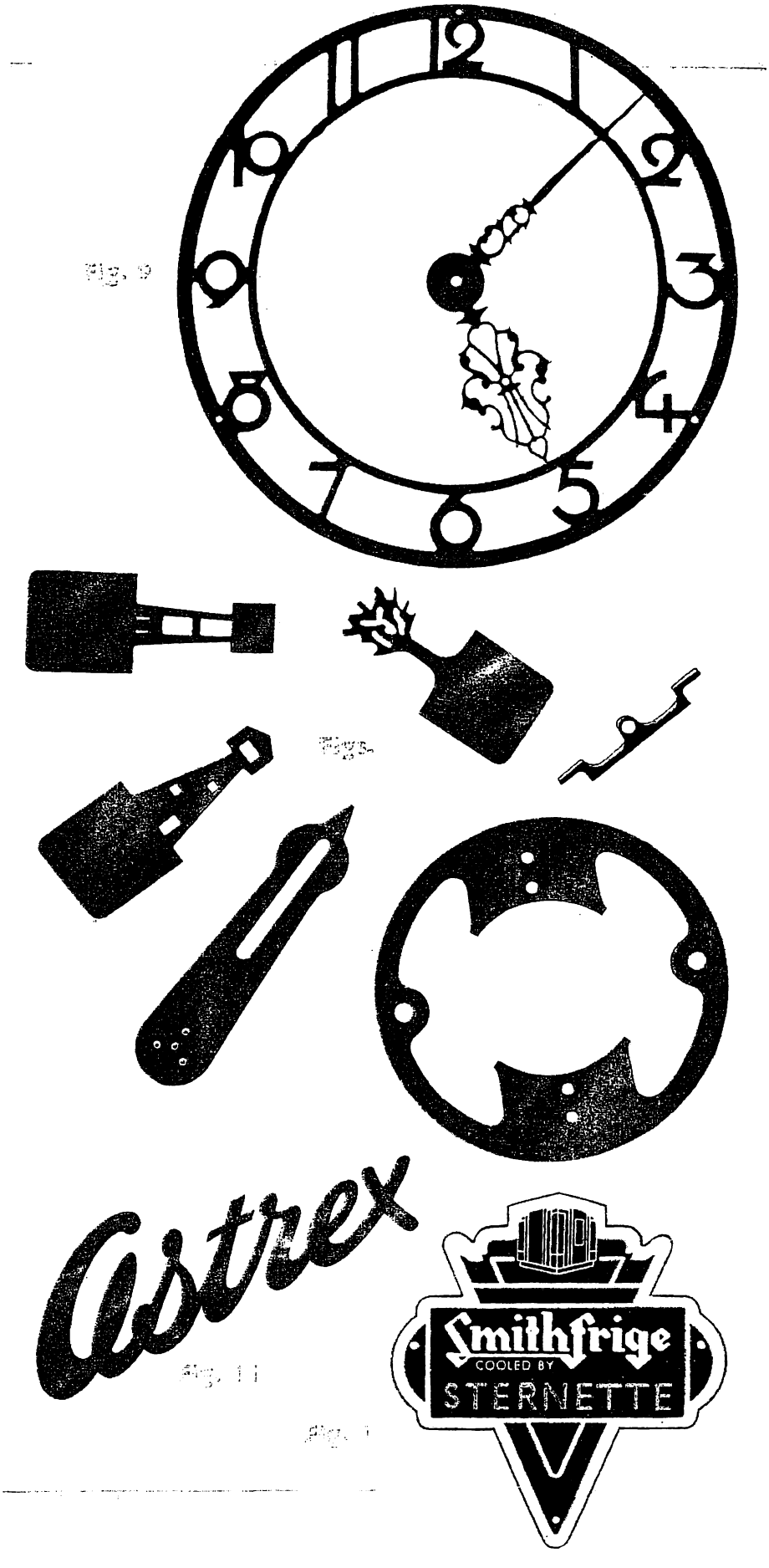


Fig. 9. The illustration of the clock dial is an example of work made from sheet metal, the engraving machine cutter cutting right through to the required shape. The copy in this case was twice size, and formed from an outline in celluloid of the dial portion, and four times the size for the two hands.

Figs. 10. The six illustrations shown opposite are good examples of producing a number of different shapes when the quantity is too large for making by hand, but not sufficient to warrant the expense of making press tools. Engraving, drilling any number of holes correctly spaced, slotting and milling can be produced at one setting.

Fig. 11. The cut-out word 'Astrex' typifies work produced in Perspex and such material for display purposes, the celluloid copy being twice size.

Fig. 12. This example of a display piece was engraved from the back of the sheet plastic in reverse and then coloured in three colours to customer's requirements. The scope and range of this class of work is very considerable, and almost every shop window display reveals examples of these semi-permanent, point-of-sale pieces.

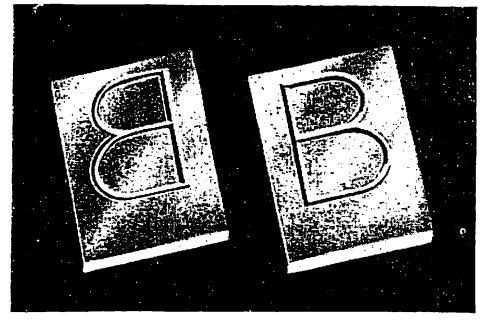
STANDARD LINE COPY CARRIED IN STOCK, SUNK AND RAISED COPY MADE TO ORDER

Showing the size of engraving which can be produced at

3:1 REDUCTION

using the different copy numbers as given in first column.

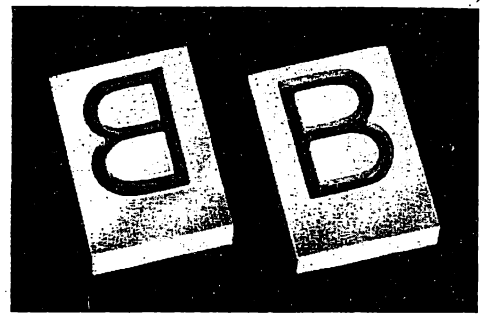
Copy No.	
2A	ABCDE 5
2L	abcde
2C	ABCDE 5
5A	AB5
5L	ab
5C	AB5
3A	A5
3C	A5
4	Aa5



Line Copy is the outline of the character, formed by a vee groove which matches with the 90° conical point of the pantograph style. With the style point maintained in good condition, the copy will have a long life. The angular section prevents the style being slack in the copy, even when the copy is worn.

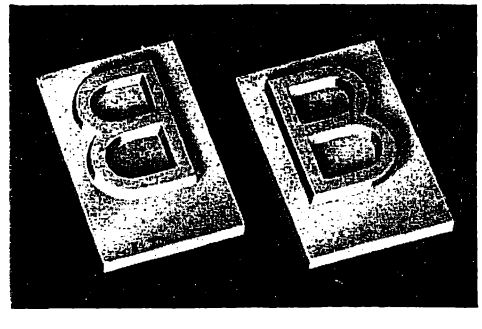
The height of the copy character is measured from centre line to centre line.

The width of line of the engraved character can be varied only by changing the cutter size.



Sunk Copy is used for engraving characters with varying widths of line, such as Roman, Old English, etc., or line characters wider than those that can be engraved from Line Copy. The style should have a flat end, and be in the form of a cylinder or a roller.

Sunk Copy is made to order in styles corresponding to the block and condensed styles of Line Copy, and in the styles shown on page 8. Also in reverse.



Raised Copy is the exact counterpart of the Sunk Copy, and can be made to order in the corresponding sizes and styles.

Raised Copy necessitates clearing away surplus material surrounding each of the work characters, and in doing this sufficient material must be left on which to engrave the next character. The copy characters should be mounted on one piece in correct relation to each other.

Sunk and Raised Copy can be used in conjunction, as may be required when making boss dies, but owing to a difference in the heights of the copy character, neither can be used in conjunction with Standard Line Copy.

Code	*Copy No.*	** Letter height* *† Bevel width*	*Sets consist of characters as below*	*For use with Copy holder No.*
110/32	**2A**	* ¾ in. (19 mm) † 1¼ in. (32 mm)	Consists of 128 characters: **A** (4) **B** (3) **C** (3) **D** (3) **E** (7) **F** (3) **G** (3) **H** (3) **I** (3) **J** (2) **K** (2) **L** (4) **M** (3) **N** (3) **O** (3) **P** (2) **Q** (1) **R** (3) **S** (4) **T** (4) **U** (3) **V** (2) **W** (3) **X** (1) **Y** (1) **Z** (1) **&** (2) **LTD** (1) **o** (2) **x** (1) **—** (1) **0** (3) **1** (3) **2** (3) **3** (3) **4** (3) **5** (3) **6** (3) **7** (3) **8** (3) **9** (3) **.** (4) **,** (4) **:** (1) **;** (1) **‘** (2) **’** (3) **+** (1) Also spacings (10 ea.): **·375 in. (9,5 mm) ·25 in. (6,3 mm) ·125 in. (3,2 mm)**	2 & 2X
110/33	**2C**	* ¾ in. (19 mm) † 1¼ in. (32 mm)	Exactly as 110/32, but narrower style characters	2 & 2X
110/41	**2A** reversed	* ¾ in. (19 mm) † 1¼ in. (32 mm)	Exactly as 110/32, but reversed copy	2 & 2X
110/42	**2C** reversed	* ¾ in. (19 mm) † 1¼ in. (32 mm)	Exactly as 110/33, but reversed copy	2 & 2X
110/34	**2L**	Lower case to match 2A or 2C † 1¼ in. (32 mm)	Consists of 102 lower case letters to combine with 110/32 or 110/33: **a** (5) **b** (4) **c** (4) **d** (4) **e** (7) **f** (4) **g** (3) **h** (4) **i** (6) **j** (3) **k** (3) **l** (5) **m** (3) **n** (4) **o** (6) **p** (3) **q** (2) **r** (4) **s** (5) **t** (5) **u** (3) **v** (3) **w** (3) **x** (2) **y** (3) **z** (2) **&** (2)	2 & 2X
110/43	**2L** reversed	Lower case to match 2A or 2C reversed † 1¼ in. (32 mm)	Exactly as 110/34 but reversed copy	2 & 2X
110/35	**3A**	* 3 in. (76 mm) † 3½ in. (89 mm)	Consists of 42 characters: 1 each of capital letters **A** to **Z**, 1 each of figures **0** to **9**, **+**, **—**, **o**, **LTD**, **&**, **x**	3
110/36	**3C**	* 3 in. (76 mm) † 3½ in. (89 mm)	Exactly as 110/35, but narrower style characters	3
110/37	**4**	* 3 in. (76 mm) † 4½ in. (114 mm)	Consists of 69 characters: 1 each of capital letters **A** to **Z** in 3A style, with **&**, 1 each of matching lower case letters **a** to **z** with **&** and **LTD**. 1 each of figures **0** to **9**, and **x**, **+**, **—**, **o**	4
110/38	**5A**	* 1½ in. (38 mm) † 2¼ in. (57 mm)	Consists of 88 characters: **A** (2) **B** (2) **C** (2) **D** (2) **E** (3) **F** (2) **G** (2) **H** (2) **I** (3) **J** (1) **K** (1) **L** (2) **M** (2) **N** (2) **O** (3) **P** (1) **Q** (1) **R** (2) **S** (2) **T** (2) **U** (1) **V** (1) **W** (2) **X** (1) **Y** (1) **Z** (1) **&** (1) **x** (1) **—** (1) **0** (2) **1** (2) **2** (3) **3** (3) **4** (3) **5** (3) **6** (3) **7** (3) **8** (3) **9** (3) **.** (2) **,** (2) **:** (1) **;** (1) **‘** (1) **’** (1) **+** (1) **o** (1) **LTD** (1) Also spacings: (5) **·375 in. (9,5 mm)** (10) **·25 in. (6,3 mm)** (15) **·10 in. (2,5 mm)**	5 & 5X
110/39	**5C**	* 1½ in. (38 mm) † 2¼ in. (57 mm)	Exactly as 110/38, but narrower style characters	5 & 5X
110/40	**5L**	Lower case to match 5A or 5C † 2¼ in. (57 mm)	Consists of 80 characters to combine with 110/38: **a** (4) **b** (3) **c** (3) **d** (3) **e** (5) **f** (3) **g** (3) **h** (3) **i** (5) **j** (2) **k** (2) **l** (4) **m** (3) **n** (4) **o** (5) **p** (3) **q** (1) **r** (3) **s** (4) **t** (4) **u** (3) **v** (2) **w** (3) **x** (1) **y** (2) **z** (1) **&** (1)	5 & 5X
110/50			1 each of letters **A** to **Z** in No. 2A style	2 & 2X
110/105			1 each of figures **0** to **9** in No. 2A style	2 & 2X
110/51			1 each of letters **A** to **Z** in No. 2C style	2 & 2X
110/106			1 each of figures **0** to **9** in No. 2C style	2 & 2X
110/645	**2A**	No. 2 Copy * ¾ in. (19 mm)	As 110/32	2 & 2X
110/647	**2C**		As 110/33	2 & 2X
110/646	**2L**		As 110/34	2 & 2X

No. 2 Copy, $\frac{7}{8}$ in. (22 mm) overall height.
Code No. 110/619. 227 Capital and lower case letters and figures.

No. 5 Copy, $1\frac{3}{4}$ in. (44 mm) overall height.
Code No. 110/618. 158 Capital and lower case letters and figures.

ABCDEFG &
123bcdefghijk&.
Presented by

No. 2 Copy, 1 in. (25 mm) overall height.
Code No. 110/653. 123 Broad capital letters and figures.
Code No. 110/652. 123 Medium capital letters and figures.

No. 5 Copy, $1\frac{1}{2}$ in. (38 mm) overall height.
Code No. 110/608. 88 Broad capital letters and figures.
Code No. 110/656. 88 Medium capital letters and figures.

No. 3 Copy, 3 in. (76 mm) overall height.
Code No. 110/607. 37 Broad capital letters and figures.
Code No. 110/648. 37 Medium capital letters and figures.

ABCDE 0456
ABCDM0 &123

No. 5 Copy, $1\frac{1}{2}$ in. (38 mm) overall height.
Code No. 110/657. 85 Capital letters and figures.

No. 4 Copy, 3 in. (76 mm) overall height.
Code No. 110/649. 37 Capital letters and figures.
Owing to the extra long tail of some of the characters, this copy is carried on No. 4 Copy strip, and fits the No. 4 Copyholder only.

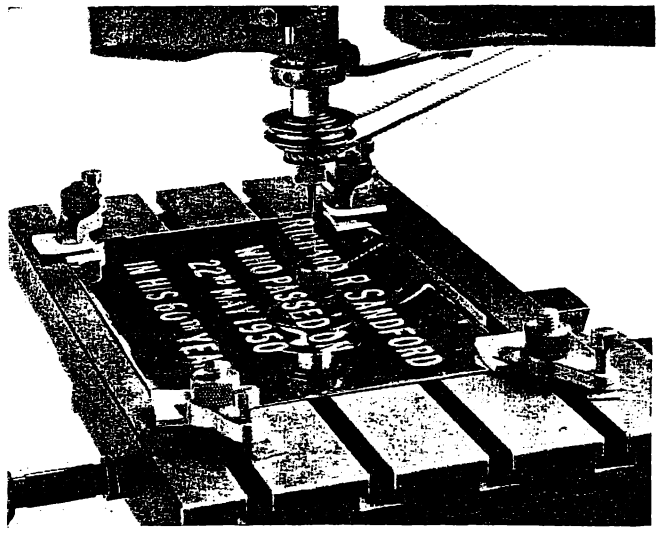
ABCDEJKQSUW
R& 123456789

No. 2 Copy, $\frac{7}{8}$ in. (22 mm) overall height.
Code No. 110/617. 227 Capital and lower case letters and figures.

No. 5 Copy, $1\frac{3}{4}$ in. (44 mm) overall height.
Code No. 110/616. 158 Capital and lower case letters and figures.

ABC MNOPZ
345 Old English.

All the copy listed on this page is also available in reverse.



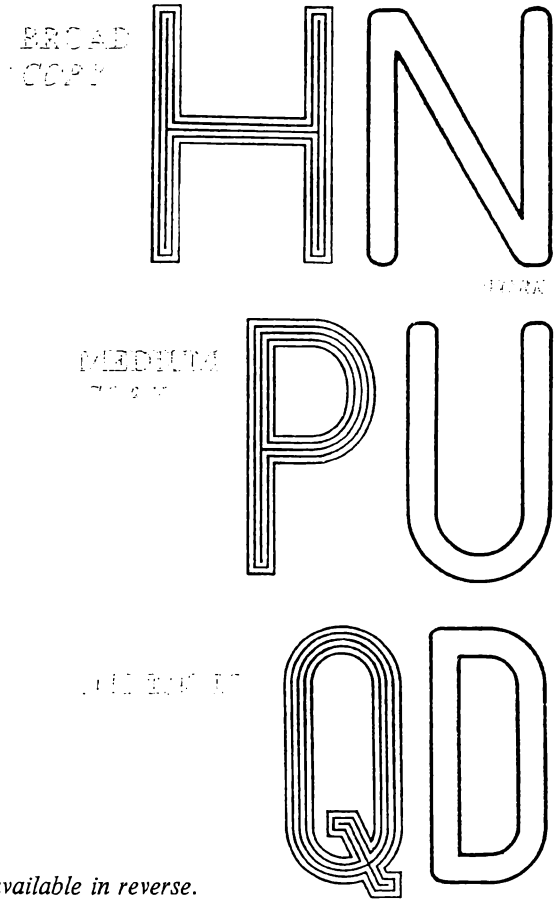
Code No. 110/622.

This is a set of condensed style Line Copy designed specifically for engraving coffin plates and small memorial plates. The set of copy is made up of words, abbreviations and characters, as listed below. It is for use in the 5X Copyholders.

JAN.—DEC. 195 . RIP. BORN DIED AGED
IN HIS IN HER YEARS AT REST

51 Large Capital Letters for use as initials $1\frac{5}{8}$ in. (41 mm) high. 99 Small Capital Letters $1\frac{1}{4}$ in. 32 mm) high.

4 Abbreviations—ST. for 1st. ND. for 2nd.
RD. for 3rd. TH. for 4th. etc.



Copy is available in reverse.

Multi Line Copy

Multi Line Copy enables the user to obtain square-ended engraved characters.

The Master Copy of each of the letters of the alphabet consists of five vee-grooves, as shown in the illustrated letters H, P and Q.

Alternatively, any selected vee-groove can be used to accommodate the 90° conical point of the pantograph style, as when engraving outline letters as illustrated, N, U and D.

Multi Line Copy can also be used to engrave other letter formations, as when using the centre vee-groove with any one or more of the other four.

It can also be used as Sunk Copy, as illustrated by the line MULTI LINE ENGRAVING. To clear away the material from within such work, the cutter must have a flat end with its diameter equal to the ratio of the width between centres of copy grooves to pantograph reduction.

No. 3 Copy, 3 in. (76 mm.) overall height.
Code No. 110/658 Broad style.
Code No. 110/659 Medium style.
Code No. 110/660 Condensed style.
All sets consist of 42 capital letters and figures.

No. 5 Copy, $1\frac{3}{4}$ in. (44 mm.) overall Height.
Code No. 110/609 Broad style.
Code No. 110/610 Medium style.
Code No. 110/611 Condensed style.
All sets consist of 88 capital letters and figures.

MULTI LINE ENGRAVING

Special Copy

Complete alphabets in Greek and Russian characters are available. Full details of copy size, number of characters supplied as a set, size of Copyholder required and price will be supplied on request.

Greek Block capital copy, corresponding to the English 'A' style, in sizes up to 3 in. (76 mm) high.

Condensed capital copy, corresponding to the English 'C' style, in sizes up to 3 in. (76 mm) high.

Lower case to combine with the block capitals, but sizes up to a height of 1 in. (25 mm) only.

Russian Block capital copy corresponding to the English 'A' style in sizes up to 3 in. (76 mm) high.

Lower case to match the above.

Other Languages

Copy can be made for any language or style of character. Customers are advised to supply prints or drawings of each character required.

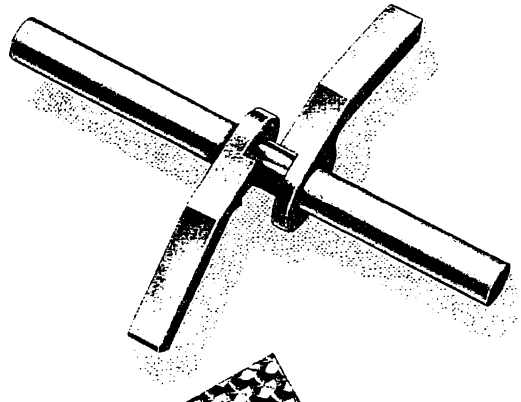
Examples shown are of Arabic and Hebrew characters engraved from copy regularly supplied to Engraving Machine users at home and overseas.

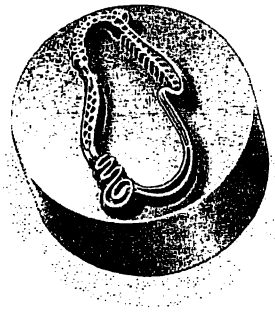
Greek

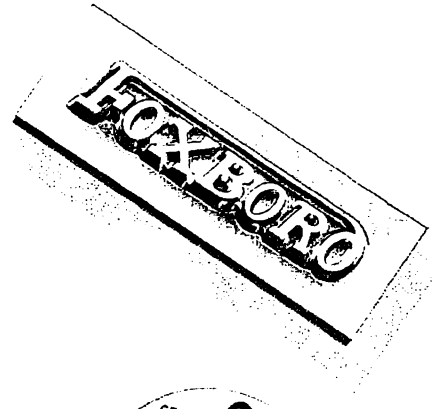
Russian

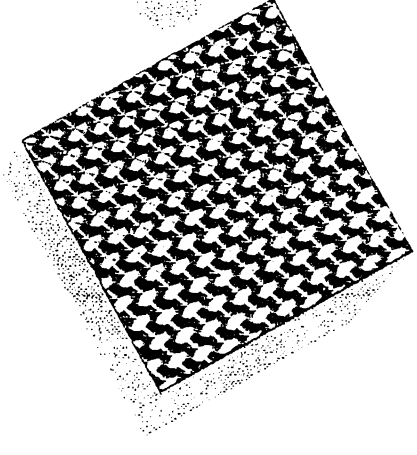
Arabic

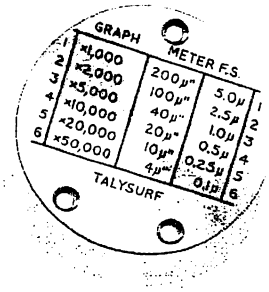
Hebrew











CUTTERS for Taylor-Hobson 'C', 'CX', 'CXL' & 'JH' Machines

Single-edge cutters are normally supplied unsharpened and are available in various diameters as shown in Fig. 1.

They are held and centred accurately in the engraving machine spindle by a taper shank. The central notch enables the cutter to be removed from the spindle with a special cutter wrench.

The cutters are made in four grades of steel and in two different forms, Rigiflat and Axiflat.

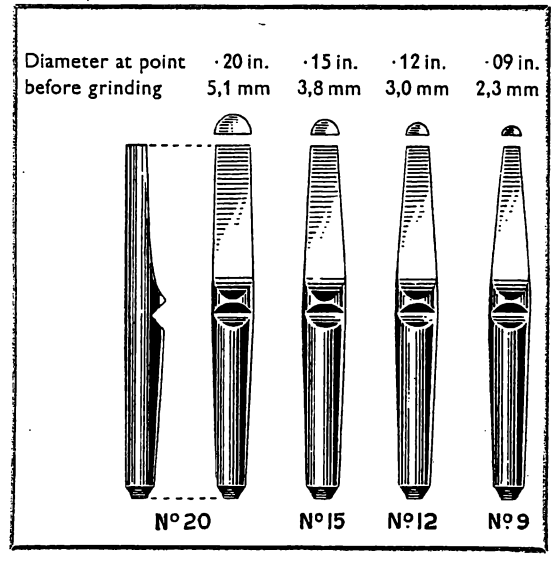


Fig. 1

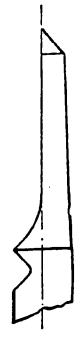
Rigiflat Cutters

Rigiflat cutters have their flats tapered about 3° to the axis, as shown, to increase their rigidity, and are preferable for heavy and general work.

Rigiflat
Fig. 2

Axiflat Cutters

Axiflat cutters have their flats ground accurately to the cutter axis throughout, so that it is unnecessary to grind the flats when sharpening the cutters. They are convenient for light cuts.



Axiflat
Fig. 3

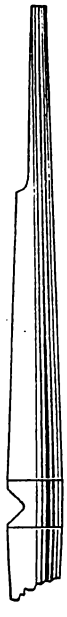


Fig. 4

Carbon Steel No. 9 Rigiflat Form

This cutter is a single-edge cutter made in Carbon Steel No. 9 Rigiflat Form. It has a blade, 2 in. (51 mm) long, and is useful for light work at abnormal depths, etc.

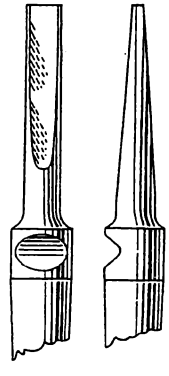


Fig. 5

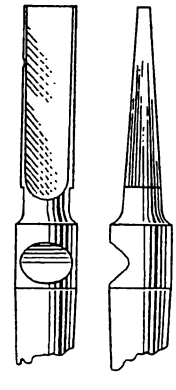


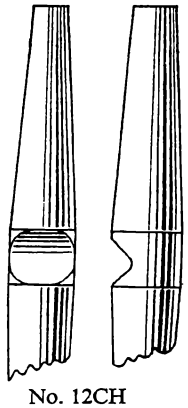
Fig. 6

Twin Edge Cutters Speedicut High Speed Steel

No. 12TH

No. 20TH

These are twin-edge cutters made in Speedicut High Speed Steel, in two sizes, Nos. 12TH and 20TH. They are used for light milling and routing processes, and give a more balanced cut on heavy cutting than the single-edge types.



No. 12CH

Fig. 7

Taper Cylindrical Form — Speedicut High Speed Steel

The taper cylindrical form of this cutter can have flats ground on it for use as a "pyramid" type of cutter. By grinding a cylindrical step on the end it may also be used as a setting plug for locating jigs and fixtures, etc. in relation to a master copy. The cutter is made in Speedicut High Speed Steel, No. 12CH.

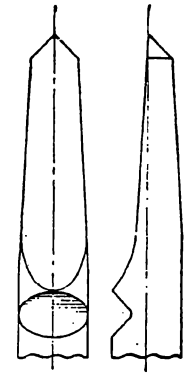
The Choice of Cutter

The requirements of each particular job are too varied to lay down any hard and fast rules, but as a preliminary guide reference should first be made to the chart on Page 14.

For line engraving, that is, engraving produced by the single width or part of the width of the cutter, the form may be a conical one, as shown in Fig. 8.

The included angle of the cone is normally 90°. Many variations may be obtained by altering the cone angle and the width of the flat (truncation) on the end of the cutter. When the engraving is to be filled with a wax filler, the cone angle should not exceed 60° (included angle).

Fig. 8



The conical point whose cut is like that of the common hand graver and is used for engraving finished work without burr.

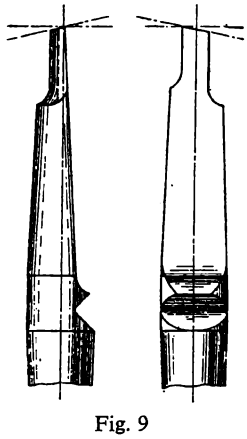


Fig. 9

Parallel cutter as ground on the Type 'D' Cutter Grinding Machine or the 'CX' Cutter Grinding Attachment.

For relief or sunk engraving, and light milling operations, where comparatively large areas of metal have to be cleared away, it is more usual to resort to the parallel type of cutter, see Fig. 9. It is advisable to avoid using truly parallel cutters where possible as they have a tendency to throw up a burr.

Cutters with truly parallel ends, as shown in Fig. 9, can only be ground on the Type 'D' Bench Cutter Grinder, or the Cutter Grinding Attachment, as offered for use with the Model 'CX' and 'CXL' Engraving Machines. The Cutter Grinding Attachment offered for use with the Model 'C' Engraving Machine is only capable of producing the modified form as shown in Fig. 10. This is because the cutting edge is ground on the periphery of the grinding wheel.

For light end milling and routing processes, see Figs. 5 and 6.

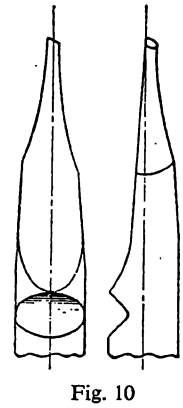
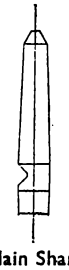
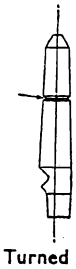
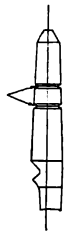
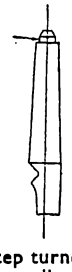


Fig. 10

The parallel or slightly conical point as ground on attachment supplied with Model 'C' machines.

Cutters are supplied in boxes of six, and this is the minimum quantity which can be supplied. Additional quantities can only be supplied in multiples of six. An exception is made in the case of Carbide Tipped Cutters and Diamond Cutters which are supplied singly.

CUTTERS for Taylor-Hobson 'C', 'CX', 'CXL' & 'JH' Machines

Types of Cutter (stocked unground)	*Sizes*	*Code Number*	*Identified by markings on shank thus:*	*Cutters recommended for use on:*
CARBON STEEL			 Plain Shank	
*Rigiflat form sharpened 90°	No. 9	110/156		Brass, Copper, Copper Alloys and the softer metals.
Rigiflat form	No. 9	110/143		
Rigiflat form (blade 2 in. (51 mm))	No. 9	110/147		Plastics
Axiflat form	No. 9A	110/146		Also a fair life on Steel and Iron.
†Axiflat form sharpened 90°	No. 9A	110/154		
TALYCUT STEEL			 Turned Ring	
Rigiflat form ...	No. 9T	110/377		Same materials as Carbon Steel Cutters, but this Steel shows a life of from 3 to 5 times that of the cheaper Carbon Steel.
Rigiflat form ...	No. 12T	110/161		
Axiflat form	No. 9AT	110/151		
†Axiflat form sharpened 90°	No. 9AT	110/153		
TALYSPEED STEEL (High Speed)			 Two Turned Rings	Cast Iron, Mild Steel and Tool Steel. Useful also on Plastics, if Carbon and Talycut Steels soften too readily through excessive heating.
Rigiflat form ...	No. 12F	110/165		
Axiflat form ...	No. 15AF	110/167		
SPEEDICUT STEEL (High Speed)			 Step turned at small end	Cast Iron, Mild Steel and Tool Steel. Useful also on Plastics, if Carbon and Talycut Steels soften too readily through excessive heating; also for Stainless Steel and Stainless Iron.
Rigiflat form ...	No. 12H	110/163		
Rigiflat form ...	No. 20H	110/164		
Axiflat form ...	No. 12AH	110/464		
Twin Edge Cutters ...	No. 20TH No. 12TH	110/465 110/466		(Ask for advice regarding procedure.)
Cylindrical Cutter ...	No. 12CH	110/467		

CUTTERS SUPPLIED SHARPENED READY FOR USE TO ORDER

*RIGIFLAT CUTTERS pointed at 90°, 60° or 30°, ready for use.

†AXIFLAT CUTTERS pointed at 90°, 60° or 30°, ready for use.

RIGIFLAT and AXIFLAT also can be ground parallel to specified sizes.

NOTE—90° Cutters are suitable for 'unfilled' engraving; 60° and 30° Cutters are suitable for engraving to be filled.

AXIFLAT CARBIDE TIPPED CUTTERS

Sharpened 60 (·005 in. truncation) Code No. 110/817
Unsharpened parallel diam. ·17 in. Code No. 110/818
Unsharpened parallel diam. ·13 in. Code No. 110/822

DIAMOND CUTTERS. Please ask for advice in connection with Diamond Cutters.

COPYHOLDERS for 'C', 'CX', 'CXL' and 'JH' Machines

Copyholders

Copyholders are made in sizes as listed having an annular seating face and are secured to the head on the machine with one fixing bolt.

All Copyholders excepting 24 in. (610 mm) long may be rotated on seating face to any desired angle and, for setting the grooves accurately parallel or at right angles to the tee-slots in the work-table, adjustable stop screws are provided which bear against abutment pads on the Copyholder in the two positions. Each Copyholder is supplied with the special copy clamps for locating the copy endwise in the dovetail grooves.

TEE SLOT COPYHOLDERS

The No. 0 Copyholder, which fits all machines, will hold flat square-edged special copy. It measures 16×9 in. (406×229 mm) and has ⅜ in. (9,6 mm) Tee slots.

Tee Slot Copyholder 110/678, which fits the JH machine has four ⅜ in. (9,6 mm) Tee slots on 5¾ in. (146 mm) pitch. It measures 20×12 in. (508×305 mm).

INTERCHANGEABLE COPYHOLDERS FOR MODEL 'C' MACHINE

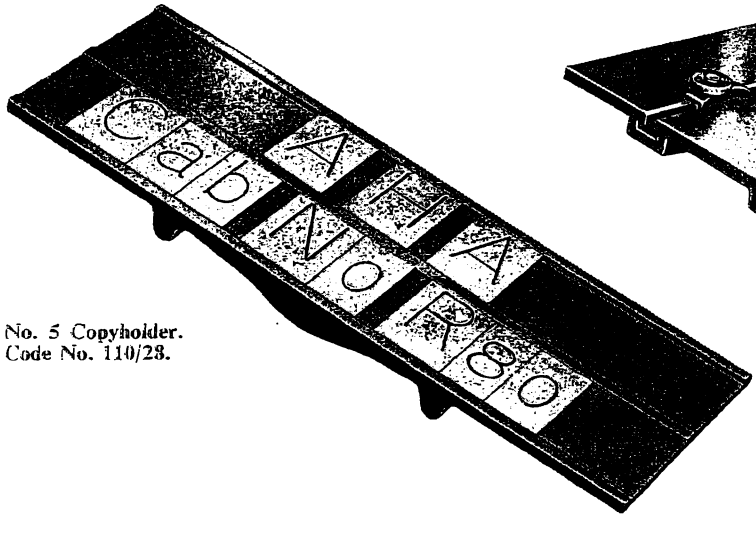
No.	Number of grooves	Length	To take Standard Copies Nos.	Code No.
2	3	16 in. (406 mm)	2A, 2C, 2L	110/22
3	1	16 in. (406 mm)	3A, 3C	110/24
4	1	16 in. (406 mm)	4	110/26
5	2	16 in. (406 mm)	5A, 5C, 5L	110/28

INTERCHANGEABLE COPYHOLDERS FOR MODELS 'CX', 'CXL' AND 'JH' MACHINES

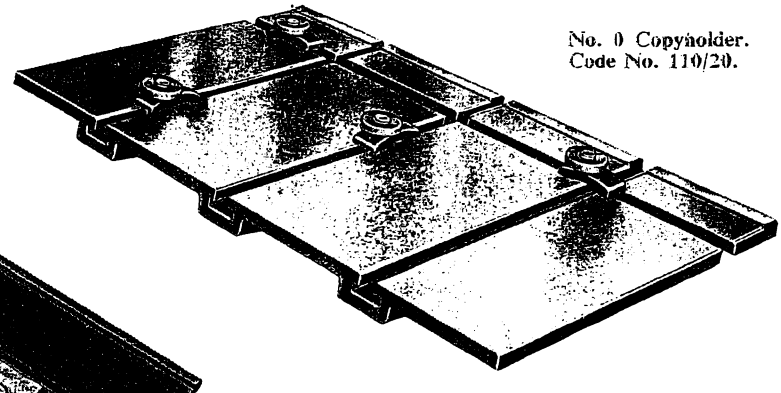
No.	Number of grooves	Length	To take Standard Copies Nos.	Code No.
2	3	16 in. (406 mm)	2A, 2C, 2L	110/22
2X	5	16 in. (406 mm)	2A, 2C, 2L	110/221
2X	5	24 in. (610 mm)	2A, 2C, 2L	110/602
3	1	16 in. (406 mm)	3A, 3C	110/24
4	1	16 in. (406 mm)	4	110/26
5	2	16 in. (406 mm)	5A, 5C, 5L	110/28
5X	3	16 in. (406 mm)	5A, 5C, 5L	110/222
5X	3	24 in. (610 mm)	5A, 5C, 5L	110/603

INTERCHANGEABLE COPYHOLDERS FOR MODEL 'JH' MACHINE

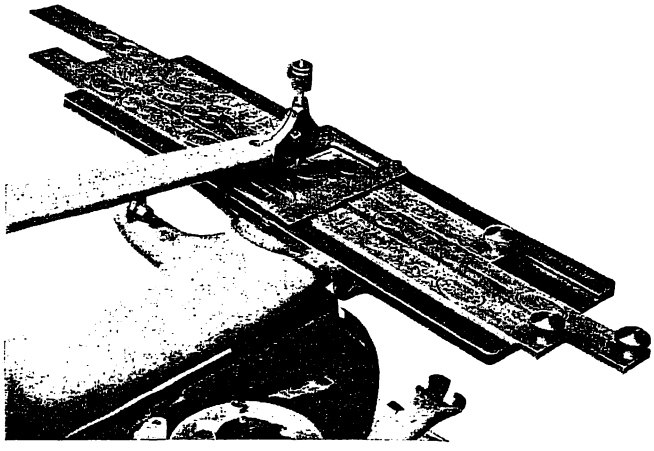
No.	Number of grooves	Length	To take Standard Copy Nos.	Code No.
2 JH	8	20 in. (508 mm)	2A, 2C, 2L	110/675
3 JH	3	20 in. (508 mm)	3A, 3C	110/676
5 JH	4	20 in. (508 mm)	5A, 5C, 5L	110/677



No. 5 Copyholder.
Code No. 110/23.

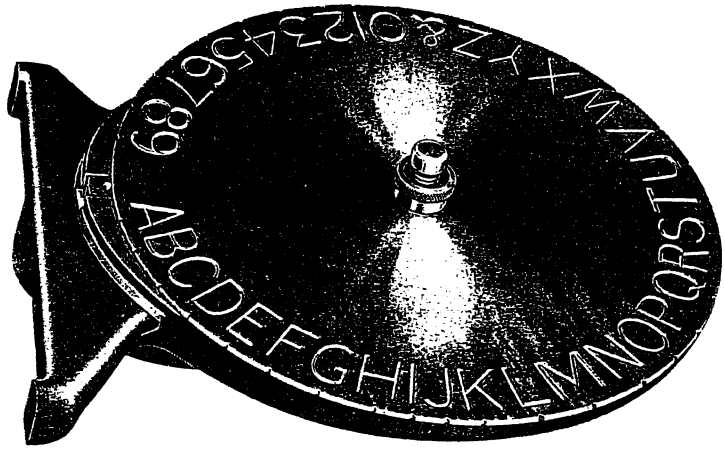


No. 0 Copyholder.
Code No. 110/20.



Special Copyholders

Special Copyholders can be useful to save time in manufacturing operations, as in the one illustrated for consecutive numbering.



Circular Copyholder

Code No. 110/30

The Circular Copyholder is interchangeable with all the Copyholders shown on page 15. It provides a means by which characters may be successively engraved on discs, cylinders, etc., and is generally used with the Dividing Head.

The copy characters are engraved on circular discs which fit on to the copyholder as shown. Standard Copy Discs are available carrying the letters A—Z and the figures 0—9, in either 'A' or 'C' style Line Copy, or both, and also in reverse. Special Copy Discs can be supplied to order. Notches round the edge of the discs engage on a spring pawl, the pawl is released by pressure on the central knob.

Copy Tray

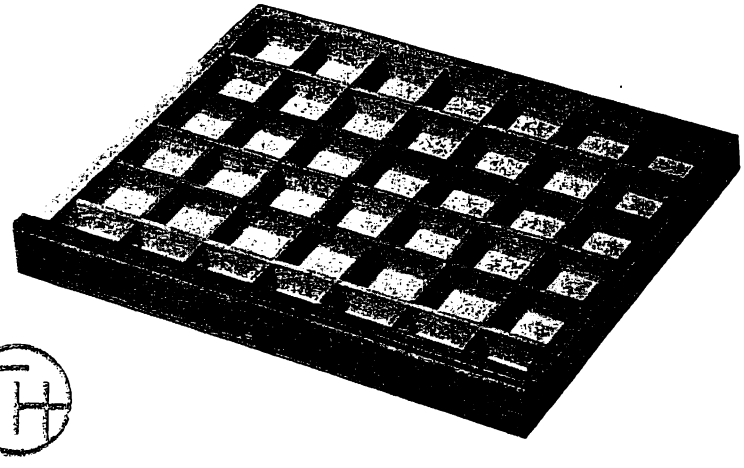
Code No. 110/623 (Factored)

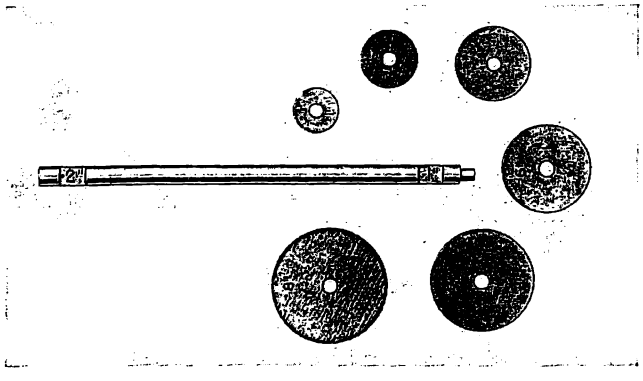
This is a wooden tray, divided into 42 sections for the convenient storage of No. 2 Line Copy.

Used as a drawer it will fit into a small tool cabinet.

Dimensions: $13\frac{1}{4} \times 10\frac{1}{4} \times 1$ in. ($337 \times 260 \times 25$ mm).
Height of polished front: $1\frac{1}{2}$ in. (38 mm).
Depth of compartment: $1\frac{3}{4}$ in. (44 mm).

A twelve-drawer cabinet can be supplied to order.

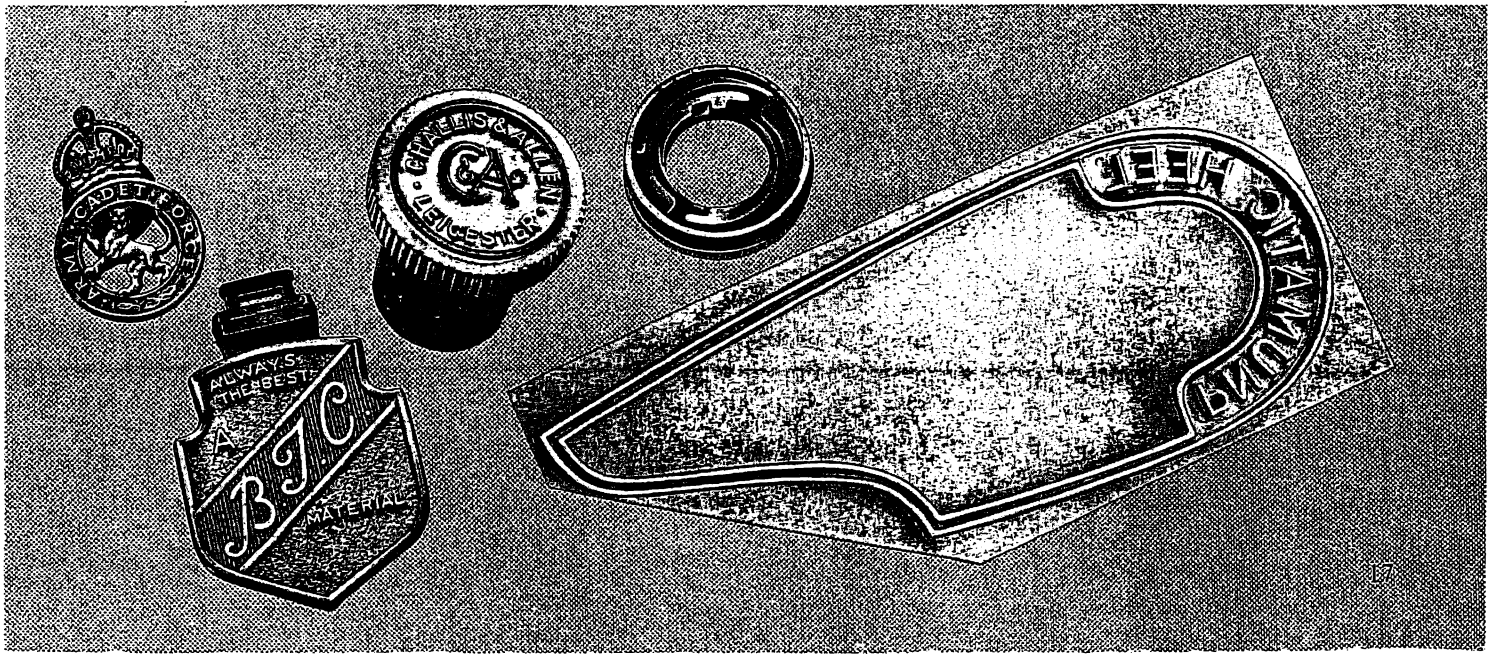


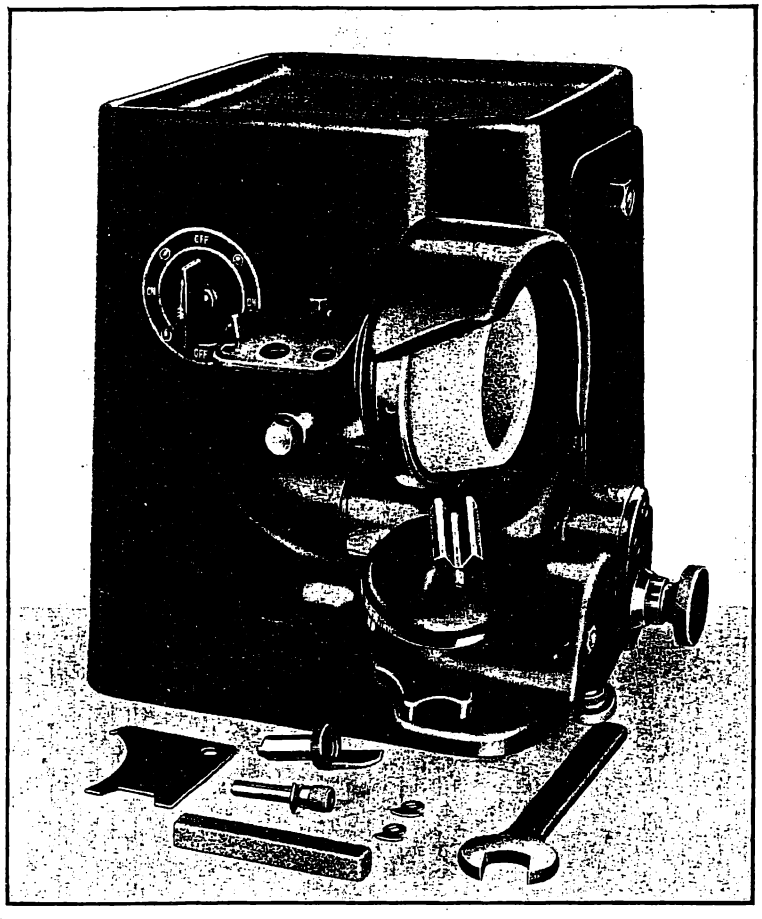


Rollers and Style

Code No. 110/66

Used to guide the pantograph around raised or sunk copy. A range of Rollers are supplied to correspond with the diameter of the cutter used.





Type 'D' Cutter Grinder

Code No. 110/353-S

In all engraving, the ultimate quality of the work produced on an Engraving Machine, is determined by the skill in the grinding of the cutter. The Taylor-Hobson Type 'D' Cutter Grinder enables users to grind cutters to a required size and shape and obtain precision results, without disturbing the machine setting and without employing skilled labour. The Cutter Grinder is sturdily built for bench mounting and all moving parts are adequately protected from abrasive dust. It is simple and safe to operate.

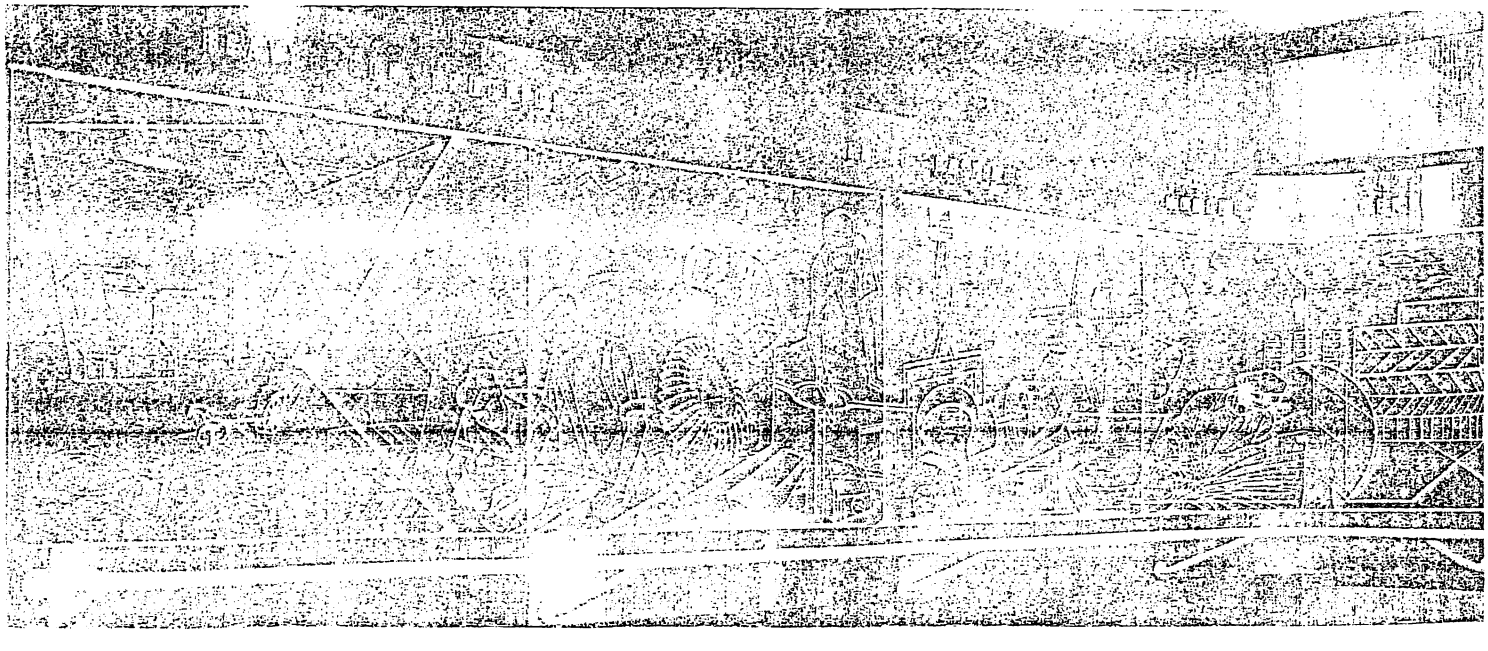
The setting gauge and set of locating cams for the cutter holder provided with the Cutter Grinder ensure precise grinding of the clearance angle. Cams normally provided are for clearance angles of 20°, 24°, 32° and 40°.

In use, the locating cam attached to the cutter holder engages on a stop pin on the tool rest, and limits the angle through which the cutter can be rotated whilst grinding.

The feed screw is graduated so that each increment represents ·002 in. (0,051 mm) on the cutter diameter, allowing for accurate grinding of the cutter diameter.

Net Weight ..	*Approx. 95 lb. (43 kg.)*
Gross Weight ..	*Approx. 115 lb. (52 kg.)*
Shipping Dimensions	*22×24×18 in. (559×610×457 mm)*

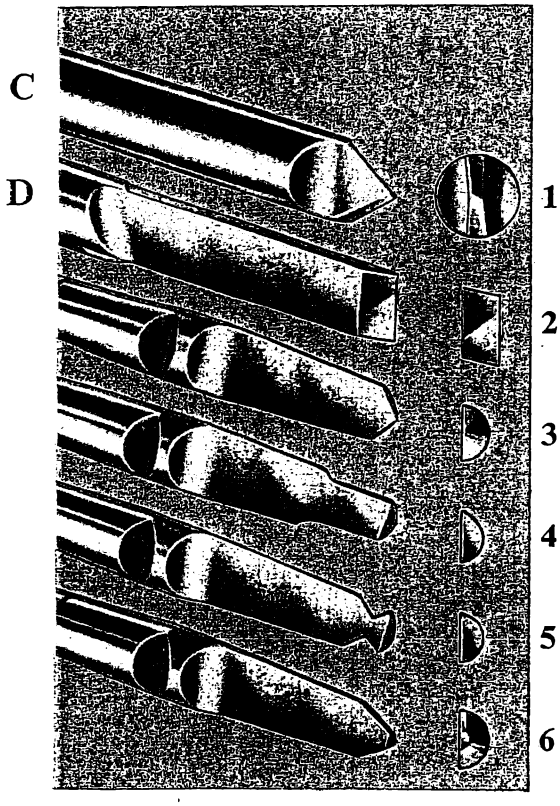
For all Engraving Machines

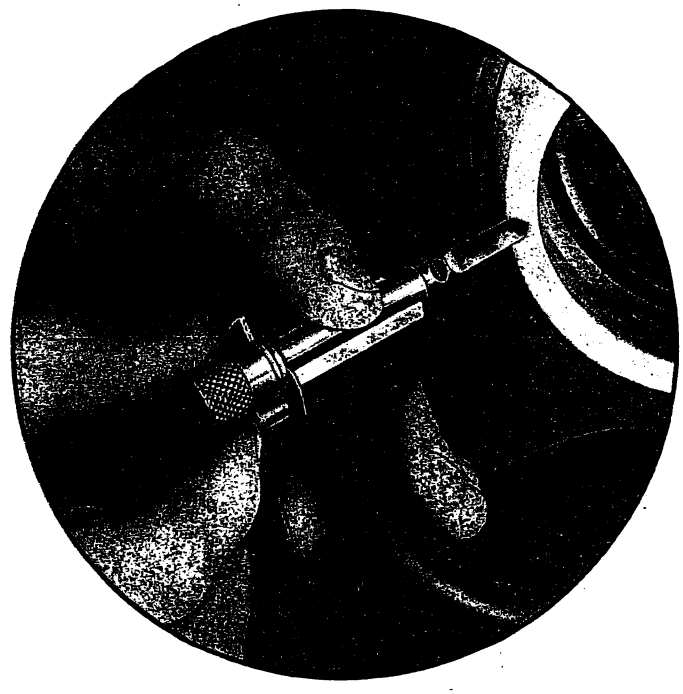


The crutch which carries the tool rest can be rotated for grinding the required shape on the end of the cutter. A scale and lock are provided. The cutter is rocked across the face of the wheel during grinding.

Special cams are required when grinding cutters with twin cutting edges (cutters C and D).

When ordering please state voltage, frequency and phase of electricity supply.

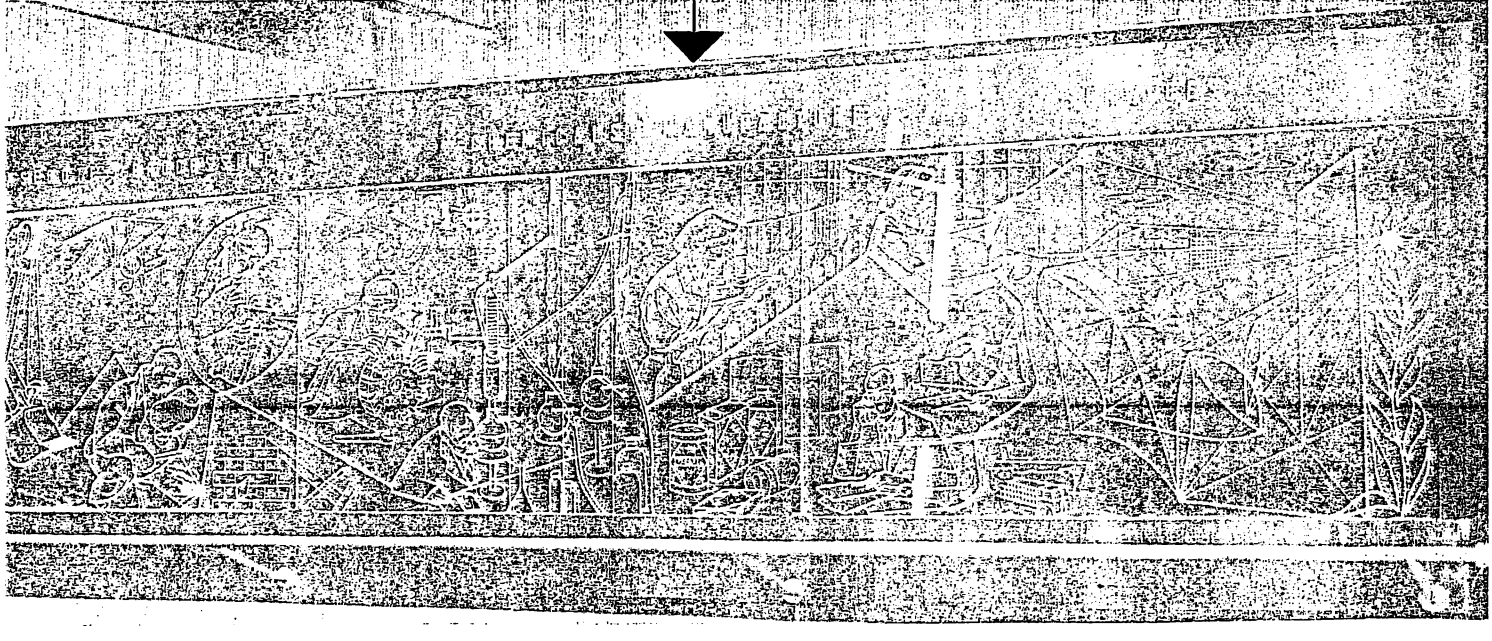




The enlarged view of the tool rest shows the Cutter Holder in greater detail. The locating cam on the end of the Cutter Holder and locating pin in the tool rest can clearly be seen. These limit the rotation of the Cutter Holder thus controlling the clearance angle on the cutter.

Type 'D' Cutter Grinder will grind the range of Cutters as shown

Eight perspex panels, size 30×24 in. (762×610 mm) with designs by John Farleigh engraved direct on each by Taylor-Hobson 'CX' Engraving Machine, and displayed as decor at the Works of Newton Chambers & Co. Ltd., Thorncliffe, Sheffield. The Engraving was executed by Parco Industries, Horsham.

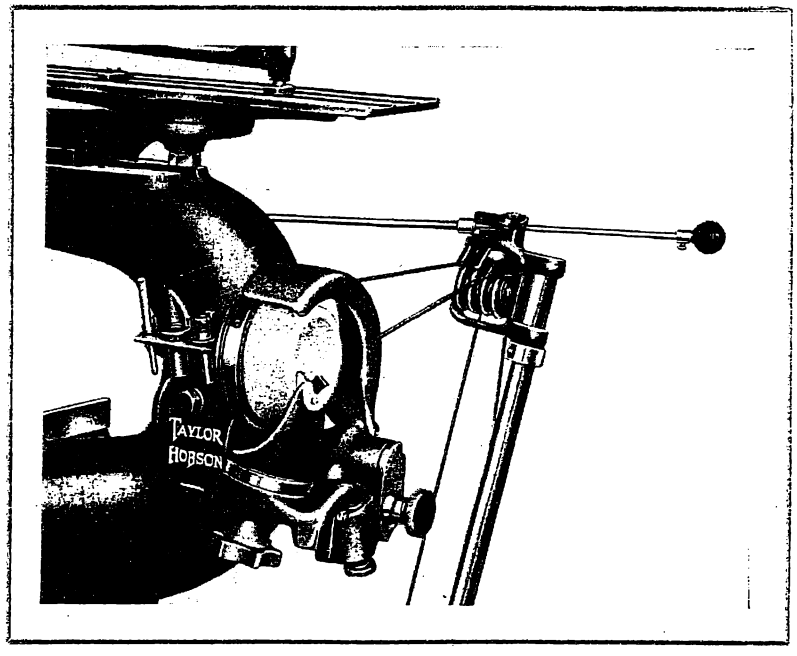


'CX' Cutter Grinding Attachment

Code No. 110/227-S

For the user of Taylor-Hobson 'CX' or 'CXL' Engraving Machines we supply the 'CX' Cutter Grinding Attachment, which will grind Cutters Nos. 1, 2, 3, 4, 5 and 6 (page 19). This comprises the standard grinding unit only of Type 'D' without the self-contained motor. The 'CX' Cutter Grinding Attachment is driven by the motor of the Engraving Machine.

The actual grinding of cutters on this attachment is identical with that of Type 'D' but the Engraving Machine is out of production whilst grinding is in progress.



Net Weight .. .. Approx. 22 lb. (10 kg.)
Gross Weight, in case .. Approx. 46 lb. (21 kg.)
Shipping Dimensions
Approx. 22 × 12 × 10 in. (559 × 305 × 254 mm)

'C' Cutter Grinding Attachment

Code No. 110/316-S

The 'one-machine-only' user of Taylor-Hobson 'C' Engraving Machine may, for economy reasons, choose this simple attachment as illustrated. Providing the operator is sufficiently skilful, cutters can be ground successfully, but this depends entirely upon how the cutter is held and maintained manually in position whilst grinding proceeds. Cutters similar to those illustrated in Figs. A and B can be ground, or any angle between, but parallel cutters cannot be ground on this attachment.

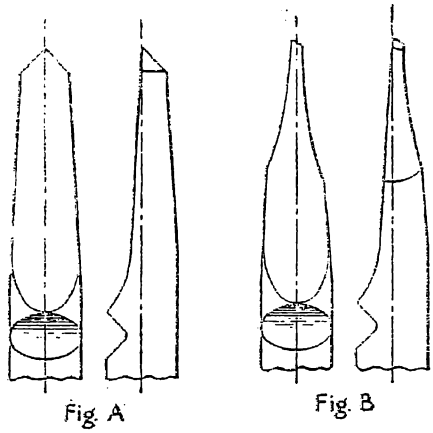
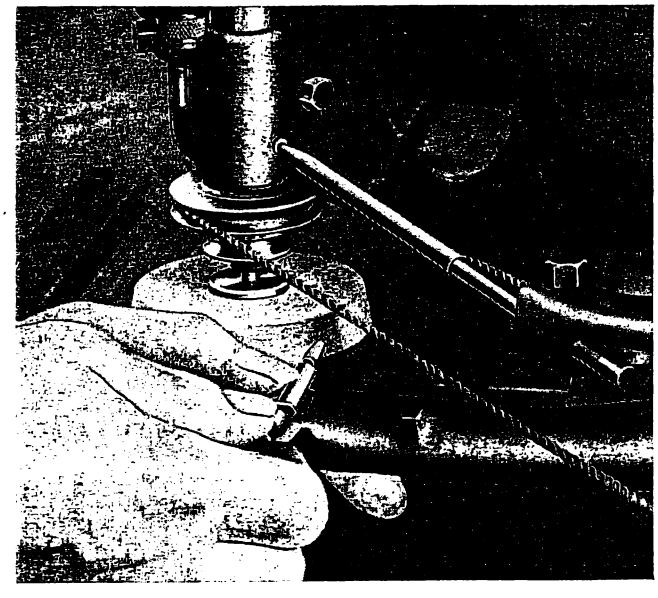
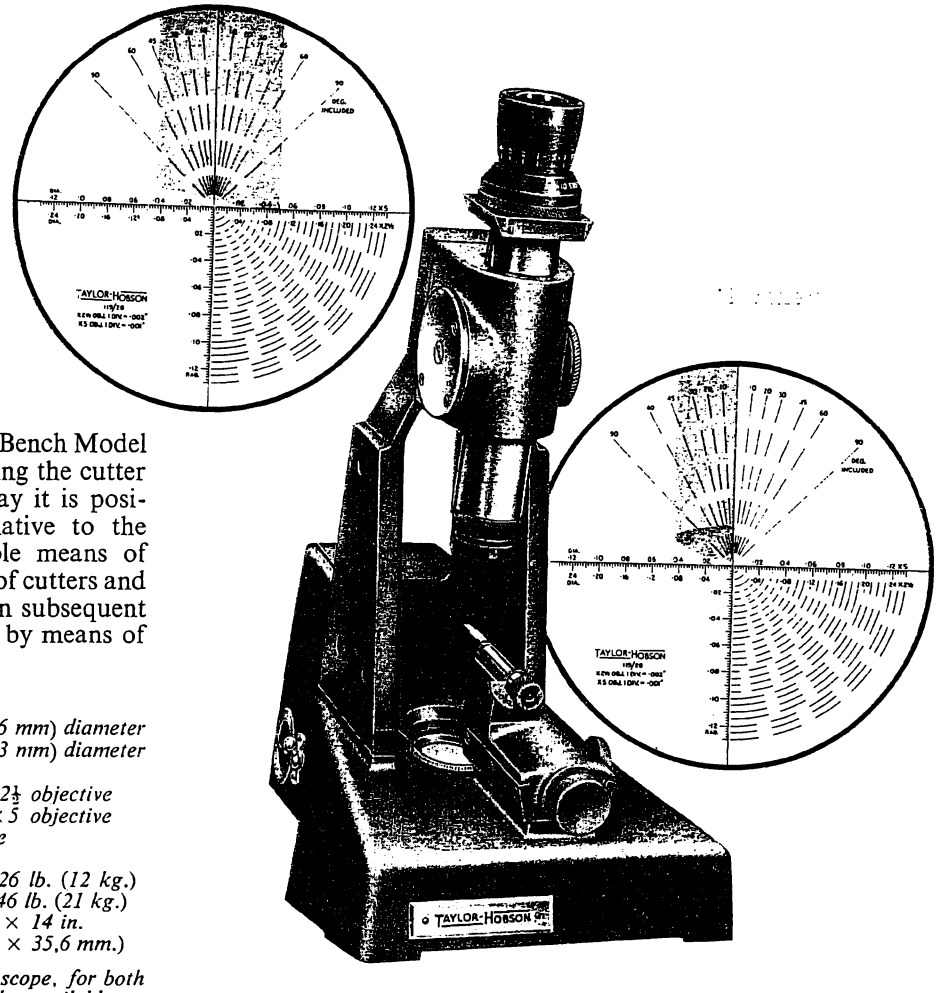


Fig. A

Fig. B



Net Weight .. .. Approx. 2½ lb. (1,1 kg.)
Gross Weight .. .. Approx. 3 lb. (1,4 kg.)
Shipping Dimensions
Approx. 12 × 5 × 5 in. (305 × 127 × 127 mm.)



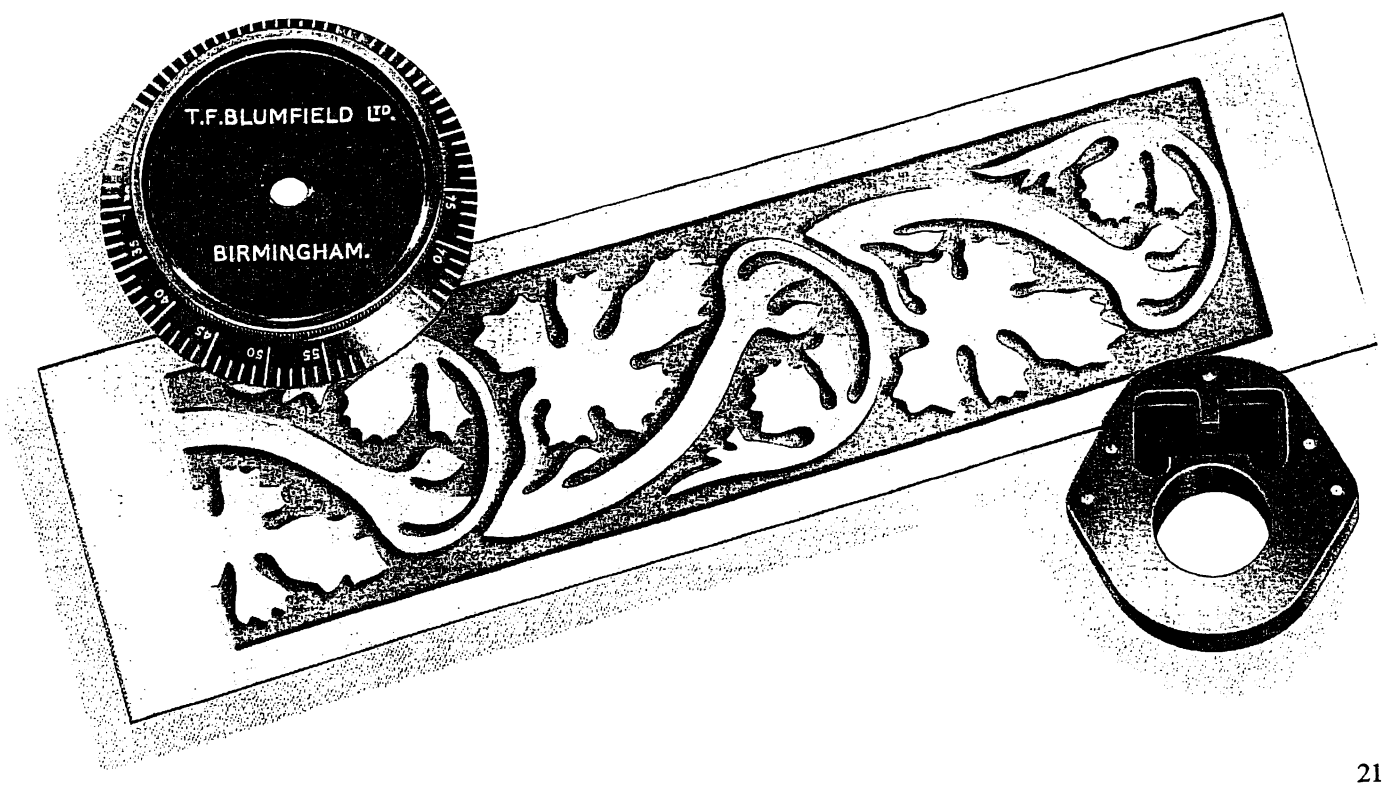
Code No. 112/292 112/293

The Cutter Measuring Microscope, Bench Model is provided with means of positioning the cutter to be measured in precisely the way it is positioned in the Cutter Grinder relative to the grinding wheel. It is an invaluable means of checking the shape and dimensions of cutters and makes possible exact duplication on subsequent grindings. Illumination is provided by means of a 12 volt lamp and green filter.

SPECIFICATION

Magnification × 25 .. *Field* ·30 *in.* (7,6 *mm*) *diameter*
Magnification × 50 .. *Field* ·17 *in.* (4,3 *mm*) *diameter*
Graticule Graduations
English { ·002 *in.* (0,051 *mm*) *with* ×2½ *objective*
·001 *in.* (0,025 *mm*) *with* ×5 *objective*
Metric { 0.051 *mm with* ×2½ *objective*
0.025 *mm with* ×5 *objective*
Net Weight .. .. .. *Approx.* 26 *lb.* (12 *kg.*)
Gross Weight .. .. .. *Approx.* 46 *lb.* (21 *kg.*)
Shipping Dimensions .. .. 14 × 14 × 14 *in.*
(35,6 × 35,6 × 35,6 *mm.*)

A Bench model Cutter Measuring Microscope, for both parallel shank and taper shank cutters is also available. (*Code No. 112/292, 112/302*).



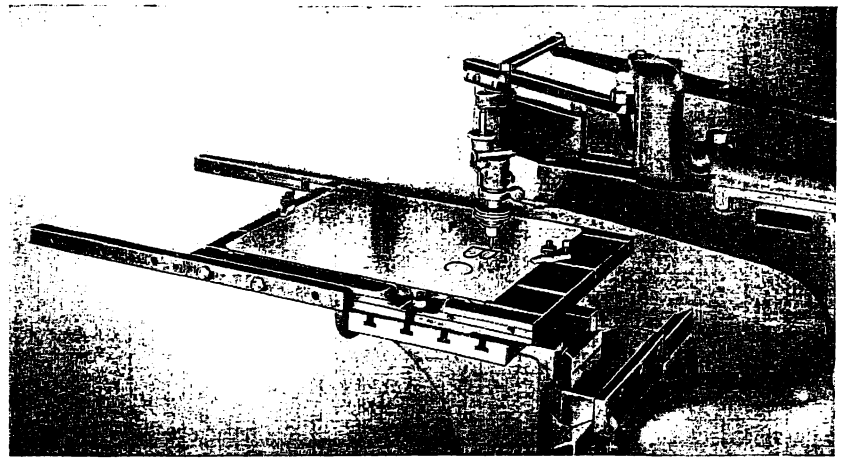
Extension Table

Code No. 110/216-S

The Extension Table for all Engraving Machines enables large plates up to 18 in. wide to be securely held on the Engraving Machine table. Work up to 36 in. (914 mm) wide can be engraved in all parts by reversing the plate.

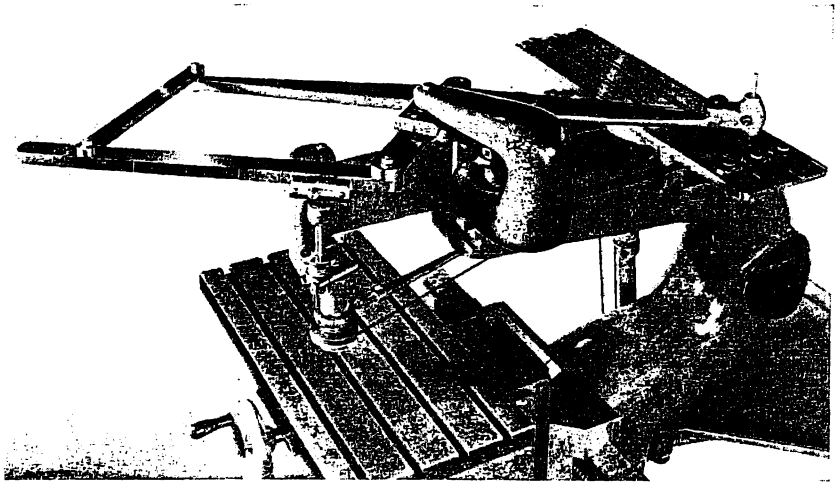
The Extension Bars also shown are a useful addition to the table, making it possible to support plates 30 in. (762 mm) wide.

EXTENSION BARS, one pair, with fixing screws. Code No. 110/240.



Extension Table
Net Weight 45 lb. (20,4 kg.)

Extension Bars
Net Weight per pair 6½ lb. (2,9 kg.)



Pantograph

Code No. 110/232

A special Pantograph is available for the 'CX' and 'CXL' Machines which covers reductions between 1 : 1 and 6 : 1. The use of this Pantograph necessitates the use of a special machine head which replaces the standard machine head; this special head is provided with the Pantograph. Using this Pantograph, characters 3 in. (76 mm) high can be engraved from standard No. 3 line copy.

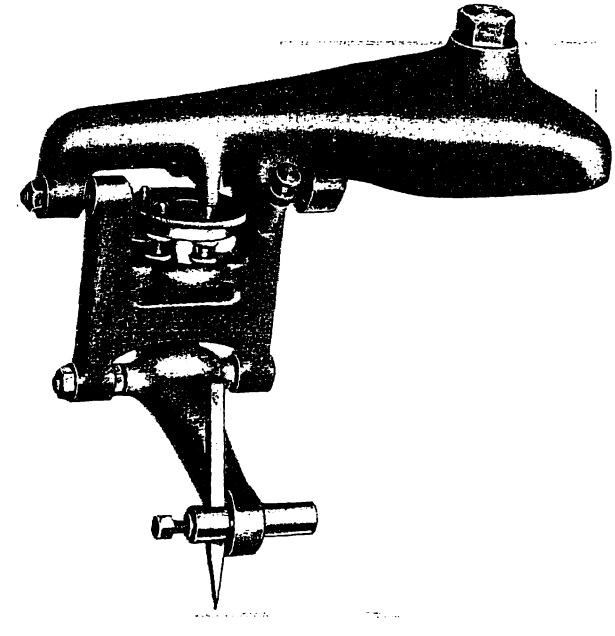
Net Weight 33 lb. (15 kg.)

Knife Divider

Code No. 110/87

The Knife Divider is an attachment to 'C', 'CX' and 'CXL' Engraving Machines, for ruling fine lines that cannot be made with a revolving cutter. It is fitted to the machine in place of the standard head. The lengths of line that can be ruled are adjustable up to a maximum of 1½ in. (38 mm) and controlled by a turret of changeable stops.

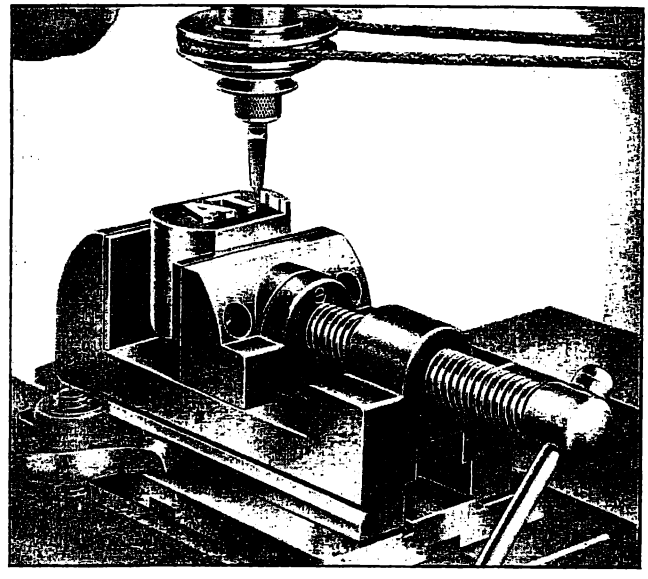
Net Weight 10 lb. (4,5 kg.)

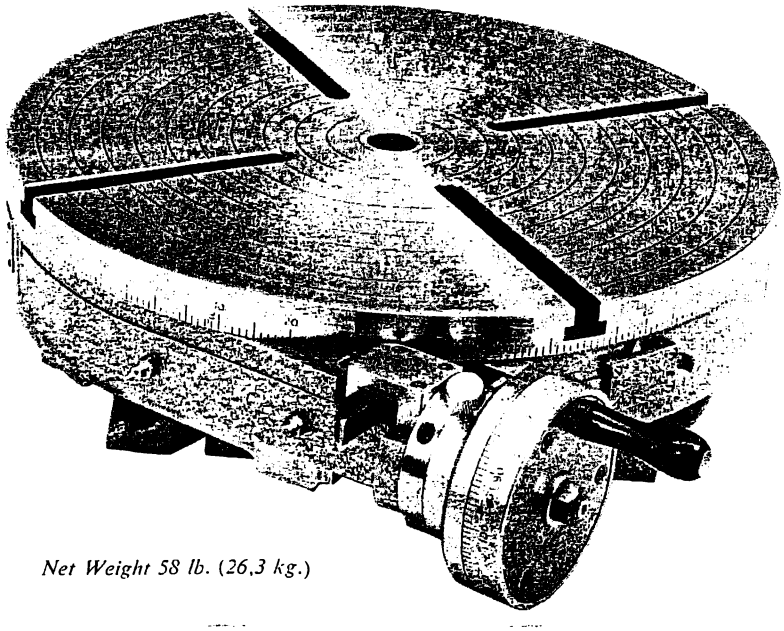


Code No. 110/17 (Factored)

The Machine Vice for all Engraving Machines for holding objects by their sides is clamped to the table by means of the standard dogs, and may be squared by means of the fence, either parallel with or at right angles to the slots in the table. The jaws, of hardened steel, are 2 in. (51 mm) wide, 1¼ in. (32 mm) deep, and open to 2 in. (51 mm). A spare jaw, having V grooves to hold cylindrical work on end or side is provided with each vice.

Net Weight 6½ lb. (2,9 kg.)

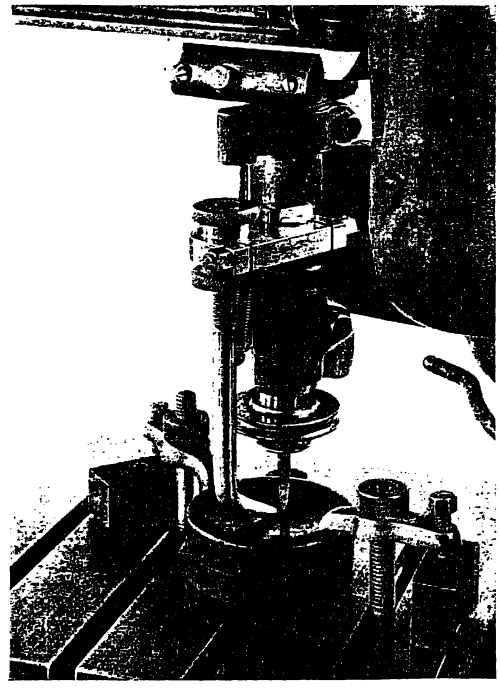




Net Weight 58 lb. (26,3 kg.)

Code No. 110/706-S

The Circular Table is for engraving and dividing circular work such as dials. It is also useful in the toolroom when accurate measurements of rotation have to be made. Slots in the base enable the Circular Table to be clamped to the machine work table using the table T slots and fittings. The 12 in. (305 mm) diameter Table is rotated by a worm, the index of which is graduated in minutes of arc; one turn of the worm corresponds to two degrees. The slots in the face plate will accommodate the machine table fittings.

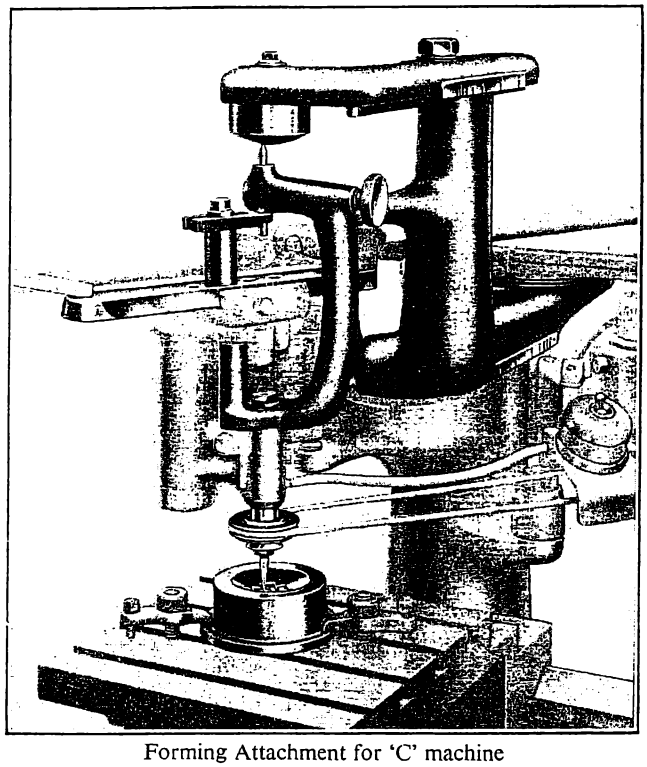


Code No. 110/230

The Presser Foot for 'C', 'CX', and 'CXL' Engraving Machines is a hardened steel gauge which rests on the work surface near the cutter and gauges the depth of cut over slightly undulating surfaces or thin materials which are apt to buckle.

It does tend to scratch the work surface and should only be used when there is a finishing operation after engraving.

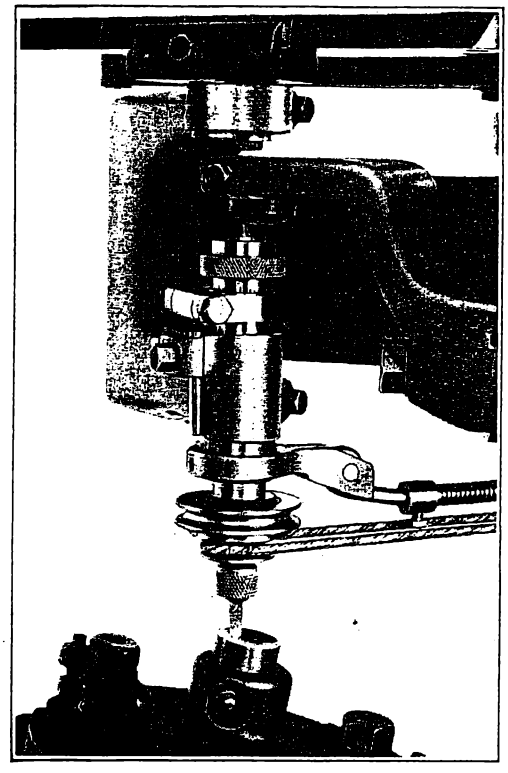
Net Weight ¾ lb. (0,34 kg.)



Forming Attachment for 'C' machine

Code No. 110/88-S

Net Weight
Forming Attachment for 'C' Machine
28 lb. (12,7 kg.)

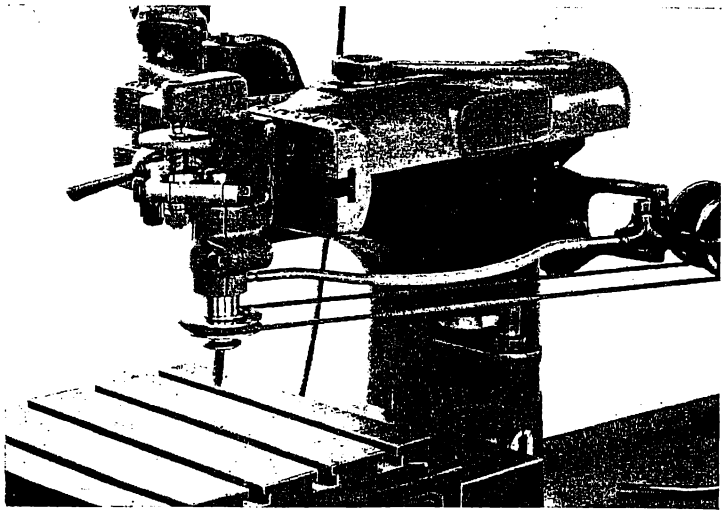


Forming Attachment for 'CX' and 'CXL' machines

Code No. 110/233

Net Weight
Forming Attachment for 'CX' and 'CXL'
3¼ lb. (1,5 kg.)

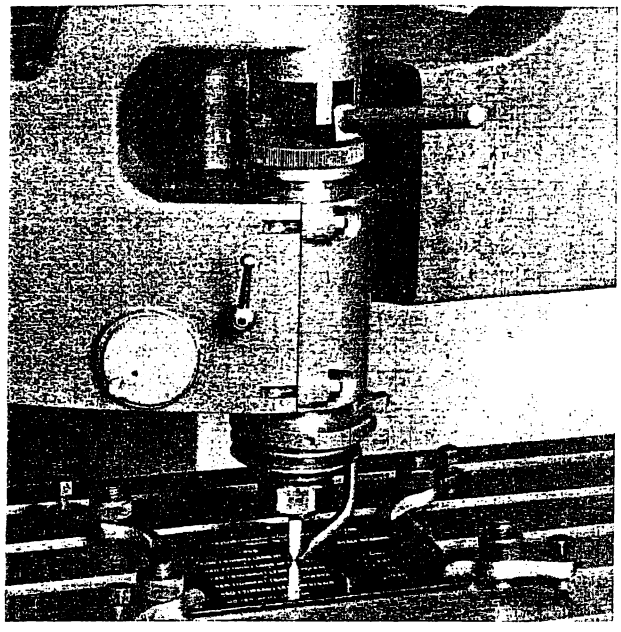
The Forming Attachments provide a means by which the cutter can be guided over a curved or undulating work surface. The maximum depth of curvature is approximately ½ in. (12,7 mm) allowing for a depth of cut of up to ⅛ in. (3,2 mm).
The form of the work surface is transmitted to the cutter by a style moving under a former which is the exact counterpart of the work surface. The Forming Attachment carrying the feeler style at the top and the cutter spindle at the bottom, is spring loaded so that the feeler is always in contact with the former. Hence as the pantograph moves the spindle horizontally over the work, the Forming Attachment causes the spindle to rise and fall to the same form as the work surface.



Code No. 110/231-S

'C', 'CX' and 'CXL' Machines as normally set up can be used as small high-speed precision millers. For heavier milling or routing which would tend to put undue strain on the pantograph, the Vertical Milling Head is extremely useful.
This attachment replaces the standard machine head and pantograph, and incorporates its own feed mechanism. The Engraving Machine drive and spindle are retained. The alternative spindle, type 'G' for parallel shank cutters can also be used. In combination with the Circular Table or the Dividing Head it provides a precision index miller.

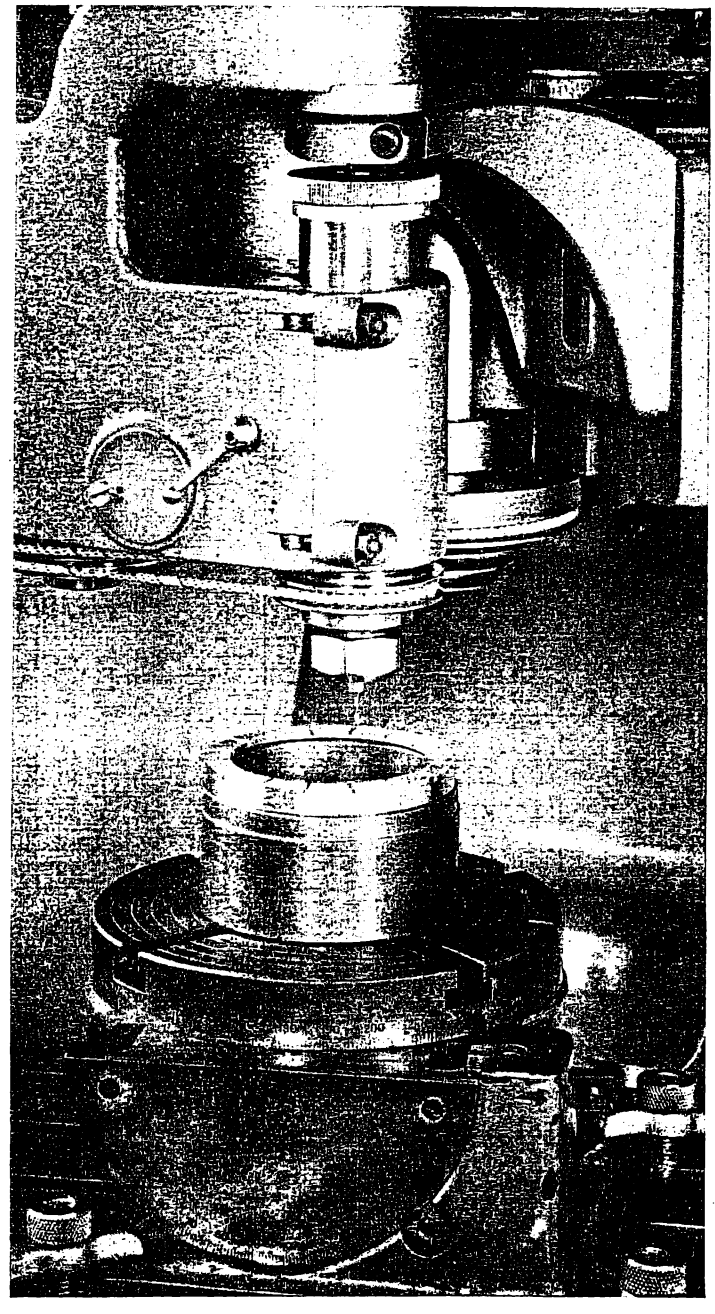
Net Weight 23 lb. (10,4 kg.)



Code No. 110/666

The presser foot feed permits the cutter to rise and fall with the shape of the work surface without being forced into the work. It is intended for maintaining an even depth of cut over surfaces which undulate or are not flat, yet do not warrant the use of a forming attachment (see page 26). It also finds application on thin work having a tendency to buckle under the action of the cutter. The presser foot feed comprises a presser foot and a feed unit, both of which are readily fitted to the standard machine. As the presser foot is of hardened steel it has a tendency to scratch certain materials and should be used only where engraving is followed by a finishing operation.

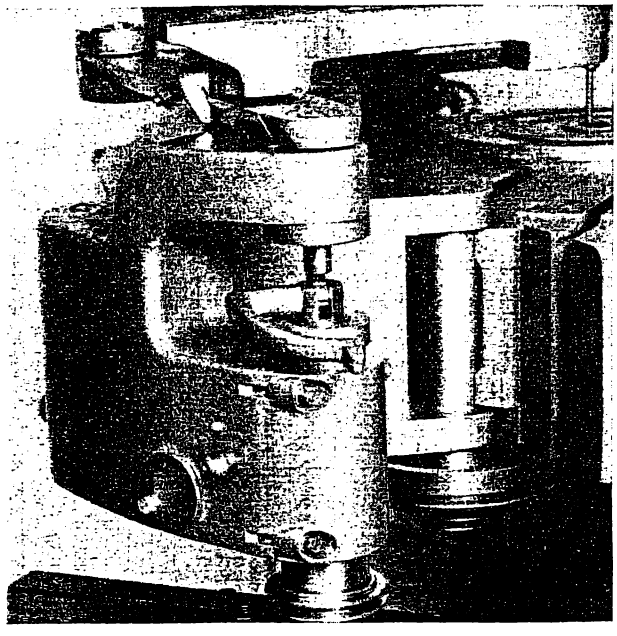
Net Weight 1 lb. 6 oz. (0,65 kg.)



Code No. 110/668

This attachment consists simply of a sturdy bracket which rigidly fixes the cutter spindle to the machine head, the pantograph taking no load. This enables heavier cuts to be taken than when the spindle is moved under pantograph control. With the milling bracket fitted, the 'JH' Machine performs as a light milling machine, the work being moved into the cutter by means of the table handwheels.

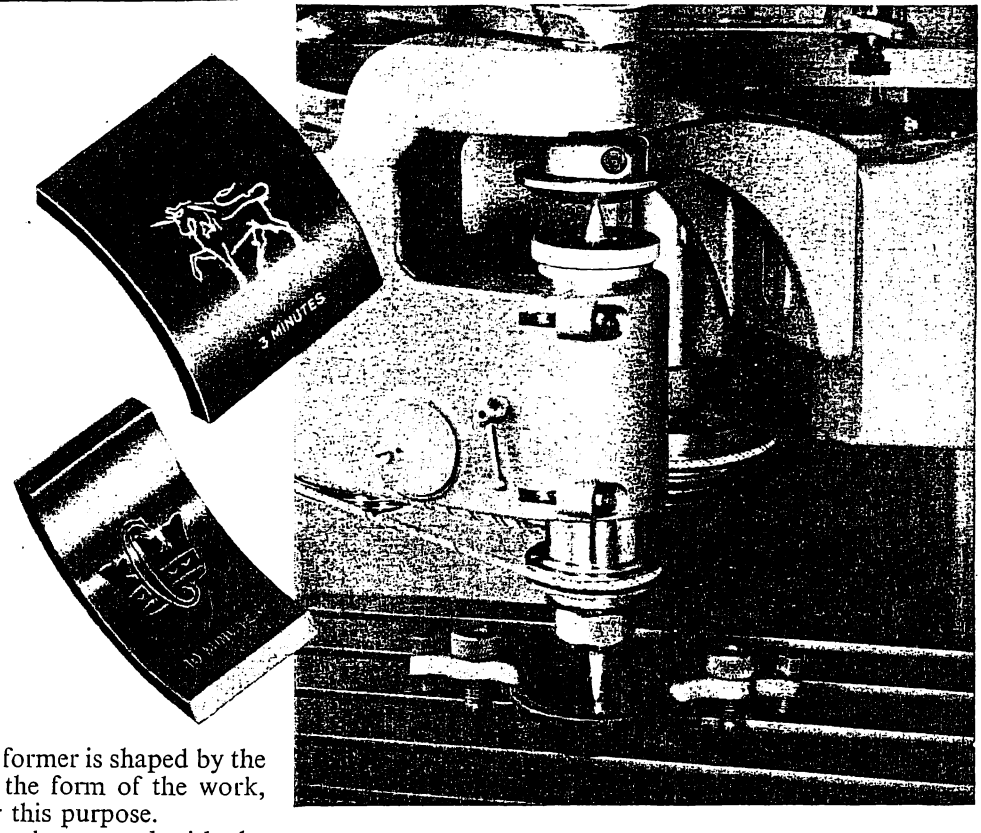
Net Weight 4 lb. 10 oz. (2,1 kg.)



Code No. 110/665

This is provided for use on light engraving, when a lever feed is preferred to the normal screw-action feed. Fitted in place of the normal knurled feed cap, the cam type feed provides a lever-operated feed of approximately $\frac{1}{4}$ in. (6,3 mm), together with an additional fine feed of approximately $\frac{1}{10}$ in. (2,5 mm). The fine feed is particularly valuable for maintaining an even width of cut on a surface which is not absolutely flat.

Net Weight 5 oz. (0,17 kg.)



Code No. 110/667

The forming attachment enables engraving to be carried out on curved or slightly contoured work. It consists of a bracket holding a former, together with a special cutter spindle feed cap. The feed cap incorporates a stylo which follows the former and imparts vertical movement to the cutter, horizontal movement being controlled by the pantograph in the usual way. The former is shaped by the user to the exact counterpart of the form of the work, former blanks being available for this purpose.

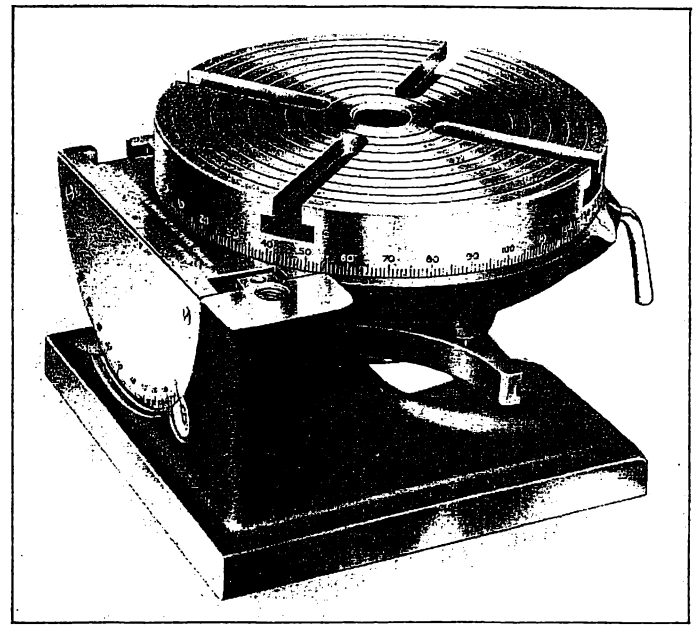
The maximum work area that can be covered with the forming attachment is a circle $2\frac{1}{2}$ in. (63 mm) in diameter, and the maximum depth of contour permissible is $\frac{1}{2}$ in. (12,7 mm).

The forming attachment includes the milling bracket (see opposite page).

Net Weight 4 lb. 12 oz. (2,2 kg.)

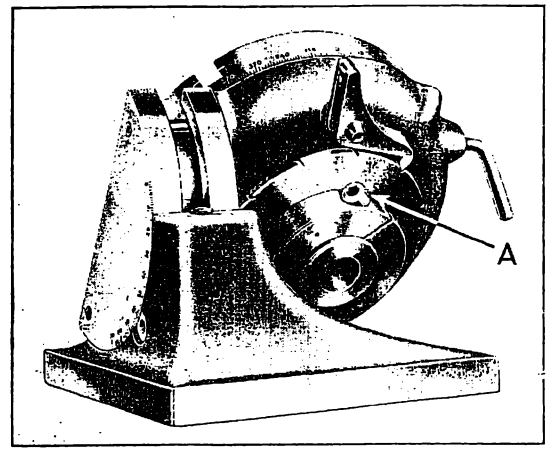
Code No. 110/79-S

The Dividing Head is used to hold and rotate circular work such as discs, cones or cylinders, so as to present successive portions to the action of the engraving cutter, and may be used together with the Circular Copyholder described on page 16. It fits on any machine. Its rotary face plate which is 6 in. (152 mm) in diameter, can be rotated by hand or clamped by a lever and can be set so that its axis is inclined at any angle between vertical and horizontal. These motions are very accurately graduated in degrees. The face plate is T-slotted to receive the standard table fittings and has a $\frac{3}{4}$ in. (19 mm) central hole for accurate centring of the work. Two dogs and bolts are provided with which to clamp the dividing head to the machine work table.



Net Weight Dividing Head 24 lb. (10,9 kg.)
Dividers for above, each $\frac{3}{4}$ lb. (0,34 kg.)

For more rapid indexing of the face plate of the Dividing Head, Dividers (see A) of steel in the form of notched discs are attachable interchangeably to the free end of the face plate shaft, as shown in the illustration. The notches engage a hardened steel pawl. The Dividers are adjustable rotationally on the shaft and the pawl may be used either way round for clockwise rotation or the reverse.
Standard Dividers, guaranteed accurate within 2 minutes of arc, are carried in stock as follows:—



Code No.	110/86	110/85	110/84	110/83	110/82	110/81
Number of divisions ...	360	180	120	90	72	12
Value of each division in degrees ...	1	2	3	4	5	30

Electric Etching

Code No. 110/184-S

The Single 'Javelin' Etcher is an attachment designed for marking metal components by an electrical etching process instead of by normal engraving methods.

It is most suitable for marking hardened steel parts which cannot be engraved by normal methods after hardening, being a perfectly clean process requiring no prior or after treatment of the surface and can be the final process on finished products.

The accessory will fit any standard Taylor-Hobson Engraving Machine and converts the machine into an electrical Etching Machine.

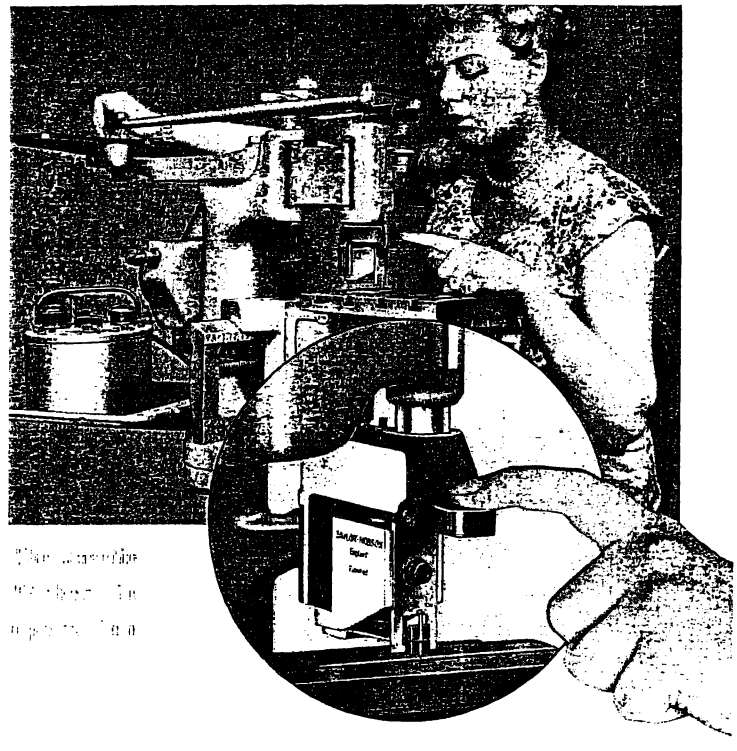
When used with the Taylor-Hobson 'JH' machine an adapter is available for this purpose. No other special equipment is needed and the Etcher is used in conjunction with standard Engraving Machine accessories, such as Copy, Copyholders, etc.

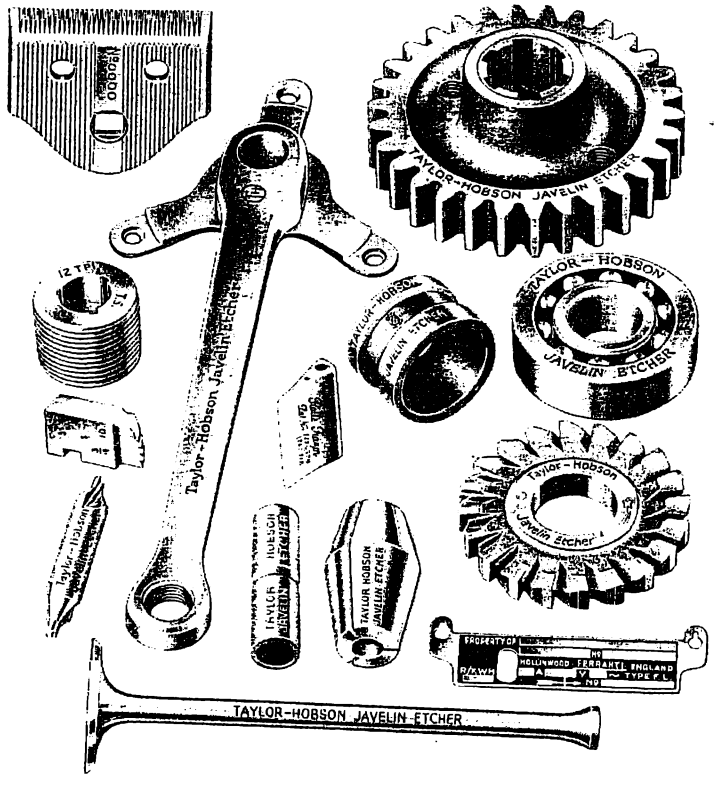
The operation is exactly the same as that employed when engraving and the Marking Unit is moved over the surface under the control of the pantograph.

The etching process has one distinct advantage over engraving, in that the 'Javelin' electrode is free to move vertically and will automatically align itself to the surface being marked. This ensures that the process is not affected by variations in flatness of the workpiece, or wear of the electrode itself. Etching can be done on cylindrical components, within certain limitations, without using special forming attachments, etc. which are necessary in normal engraving.

The Etcher can only be operated on a single-phase electrical supply but can be supplied to suit a 50 or 60 cycle frequency.

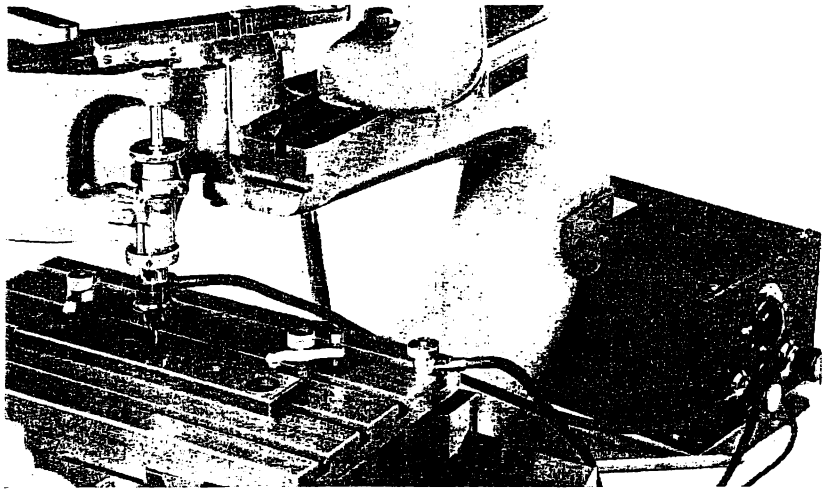
The Single 'Javelin' Etcher consists of a Marking Unit which is fitted in place of the normal Engraving Machine Spindle and a Transformer.





Net Weight	25 lb.	(11,3 kg.)
Gross Weight	36 lb.	(16,3 kg.)
Shipping Dimensions	16 × 10 × 12 in.	
	(406 × 254 × 305 mm.)	

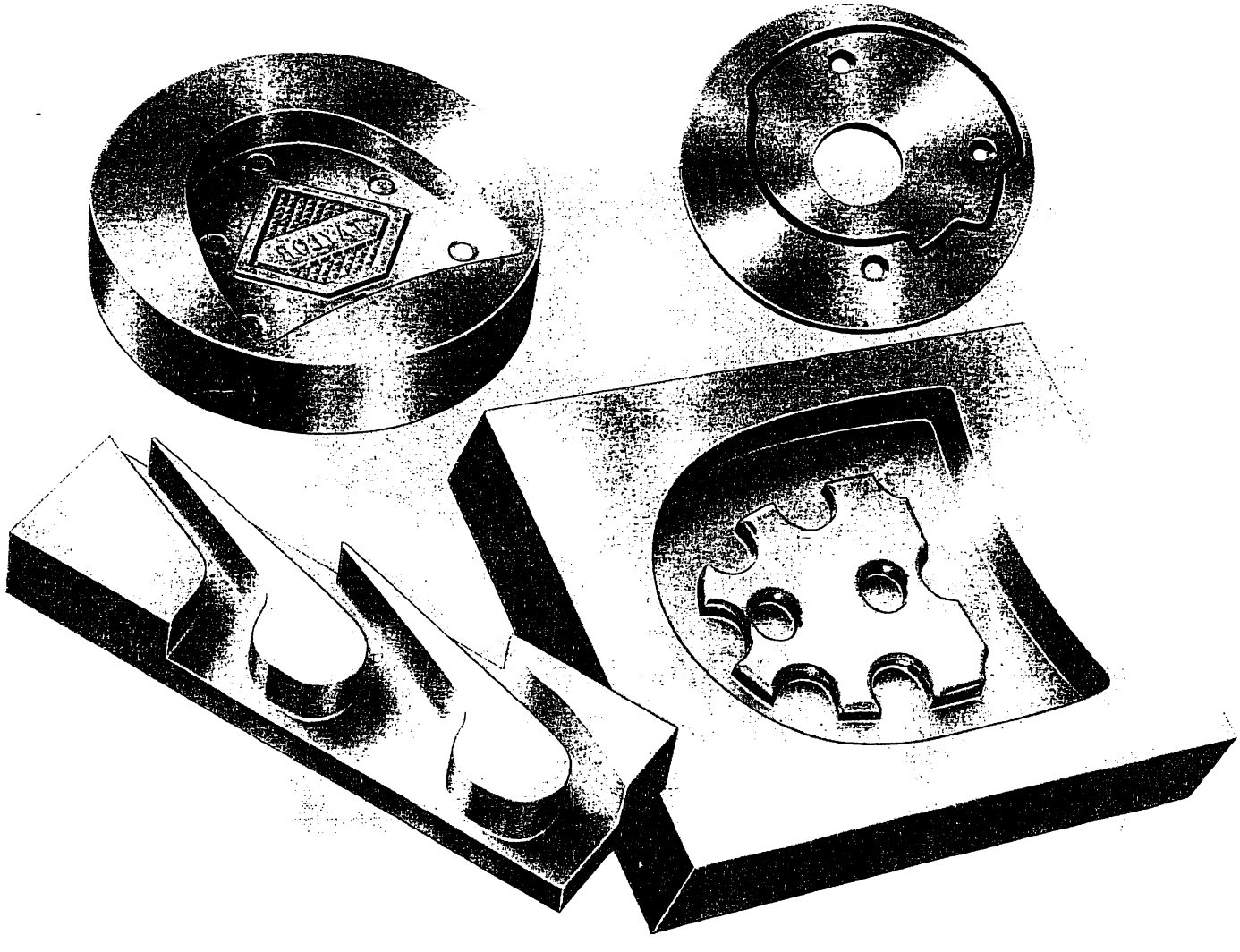
The word 'Javelin' is a registered trade mark of Taylor, Taylor & Hobson



Although normally supplied for use freehand, the Electric Resistance Etcher can be used on copying machines. The writing unit replaces the rotary cutter spindle, as shown in illustration. The electrode marks the object by heating it along the path of contact by means of a low voltage current from a special transformer. It will etch any hard or soft metal offering a high resistance to the electric current, including tool steel, stainless steel, and stellite tungsten carbide.

This equipment is very useful in tool rooms for identifying and marking tools, etc.

Net Weight 32 lb. (14,5 kg.)



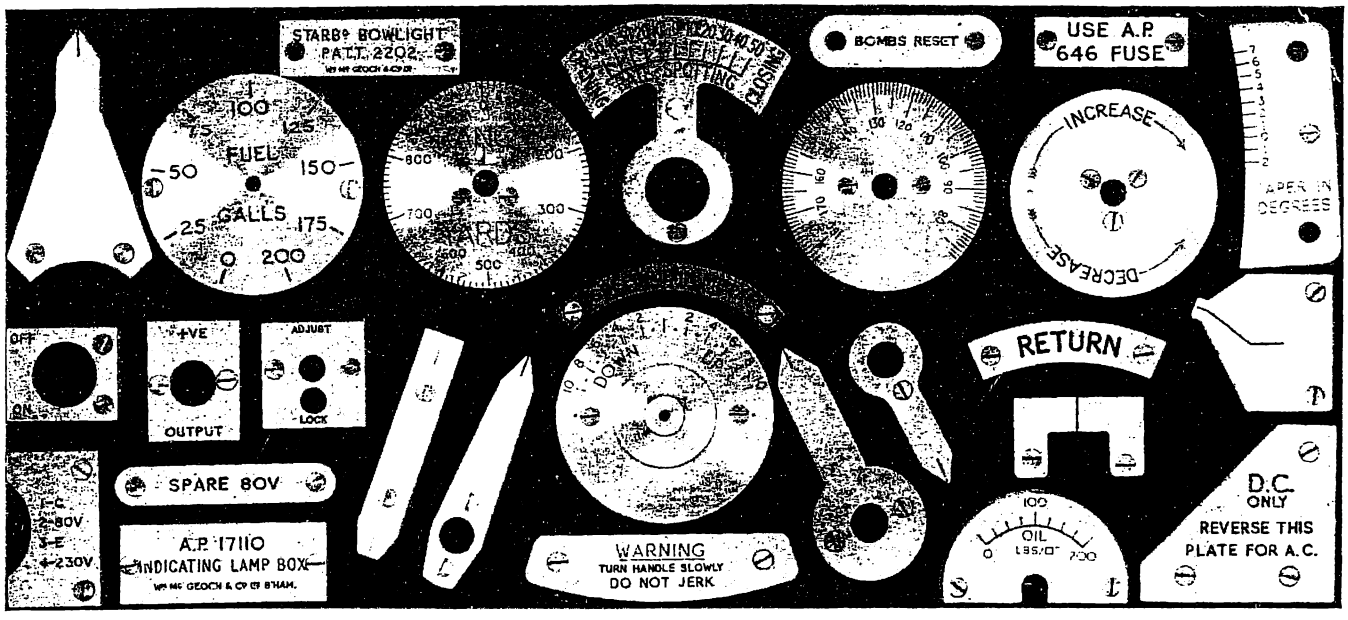


Illustration by courtesy of Thos. A. Ingram & Co., Prescott Works, Prescott Street, Birmingham

A typical selection of brass labels, dials, scales and pointers which were machine engraved, divided, calibrated and profiled on Taylor-Hobson Engraving Machines.